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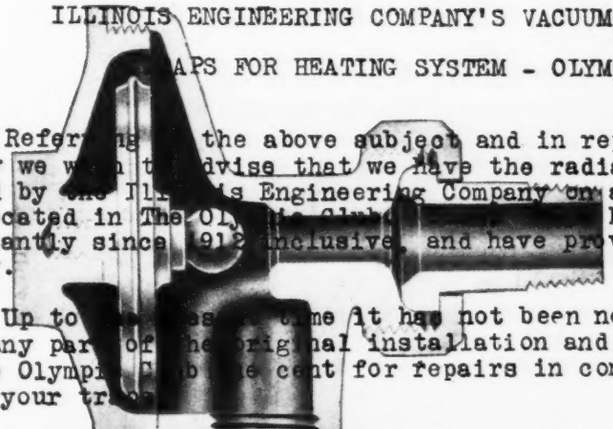
The Olympic Club
San Francisco

April 8, 1924.

Mr. Jas. I. Krueger, Representative,
Illinois Engineering Company,
417 Market St. San Francisco.

Dear Sir:

ILLINOIS ENGINEERING COMPANY'S VACUUM RADIATOR
APS FOR HEATING SYSTEM - OLYMPIC CLUB.



Refer[illegible] the above subject and in reply to your inquiry we w[illegible] advise that we have the radiator traps manufactured by the Ill[illegible]is Engineering Company on all of the radiators located in The Ol[illegible] Club [illegible] have been in use constantly since [illegible]91[illegible] inclusive, and have proven very satisfactory.

Up to [illegible] time it has not been necessary to replace any par[illegible] of the original installation and it has not cost The Olympi[illegible] Club [illegible] cent for repairs in connection with any of your tr[illegible]

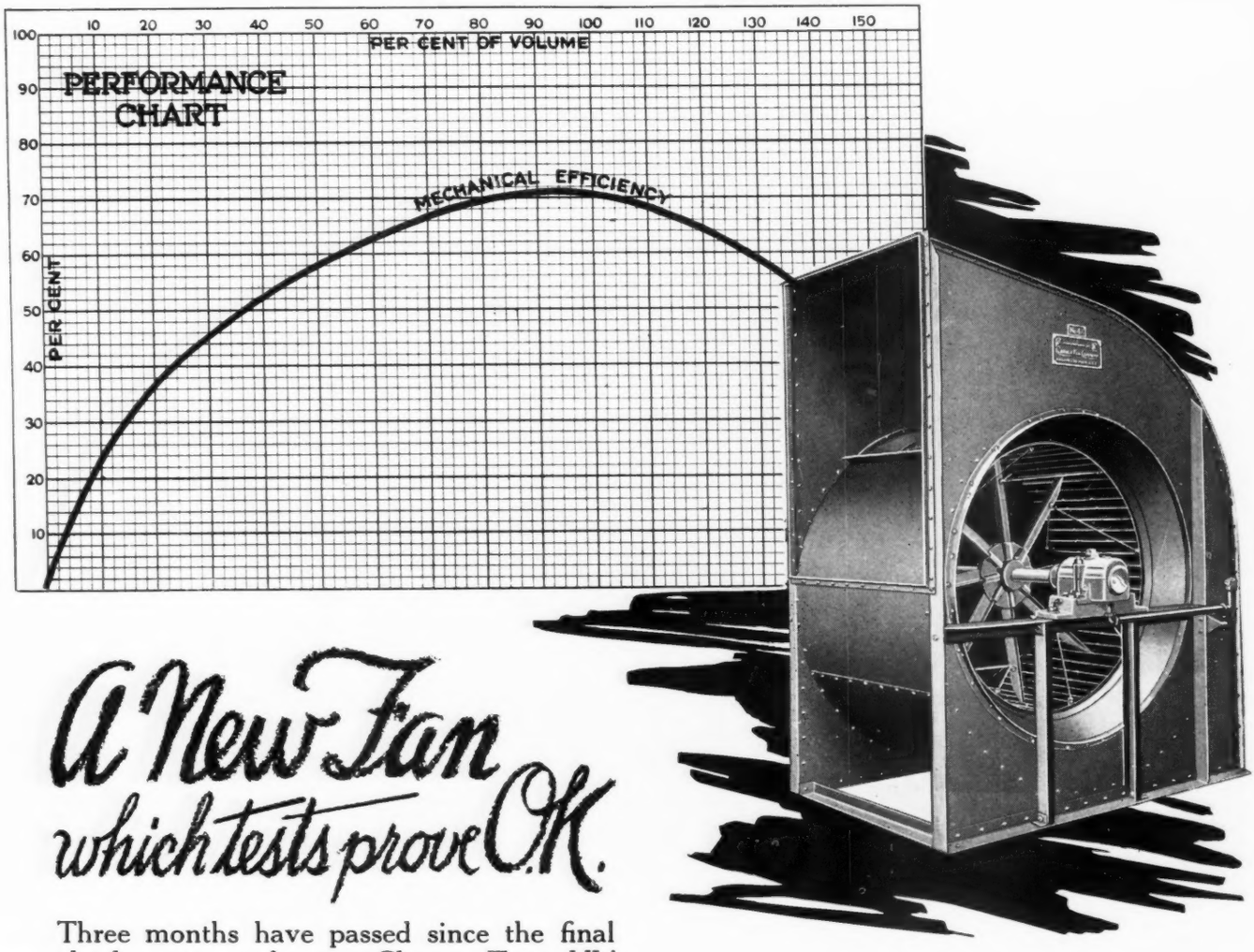
From a review [illegible] experience with this equipment we are of the opinion that it gives excellent, economical service and that the maintenance cost is practically negligible.

Very truly yours,

Kenneth McEd[illegible]
Manager

Frank Thomas
Chief Engineer.

ILLINOIS ENGINEERING COMPANY-CHICAGO


PERFORMANCE CHART
PER CENT OF VOLUME
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
100 90 80 70 60 50 40 30 20 10
PER CENT
MECHANICAL EFFICIENCY

A New Fan which tests prove O.K.

Three months have passed since the final check tests on the *new* Clarage Type HV Multiblades were completed—curves plotted and charts drawn.

These check tests *proved* what preliminary tests had previously pointed out—that for efficient operation the HV Multiblades are unusual.

Consider these facts, as related to this Clarage product:

1. *Highest* efficiency attained in the range of operation, as used in heating and ventilating.
2. Efficiency of over 60% with a 60% change of volume.
3. Maximum efficiency 72%.

Brushing aside the over-enthusiasm which, as manufacturers, we naturally have for these fans and speaking conservatively as engineers, we do not know of *any* other fans *exceeding* the HVs in maximum efficiency—nor have we any data on similar equipment which maintains such a high efficiency (60%) over such a *wide* operating range.

The HV Multiblades are now in production and are available in a complete range of sizes to cover all requirements.

The catalog is not ready, but we can send you an interesting preliminary bulletin and capacity tables on any sizes required. Become acquainted with the performance of the *new* Clarage HVs!

CLARAGE FAN COMPANY
HOME OFFICE & WORKS: *Kalamazoo, Michigan*
SALES ENGINEERING OFFICES IN SIXTEEN CITIES

CLARAGE TYPE HV MULTIBLADES

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OCTOBER, 1924

Comparative Costs and Heat Emission for Cast-Iron Direct Radiation

With Detailed Data For Eight Different Radiator Heights and Wall and Window Radiators

By T. W. Reynolds

AS THE heat transmission of radiation varies with the height, width and length of radiators, as well as with the temperature of the steam and of the room, it is desirable that these factors be taken into consideration, in order that each radiator selected will give a maximum of heat emission at minimum first cost. Of special interest in this connection are the following tables giving the comparative costs of cast-iron direct heating surface of various heights, number of columns and sections, where the efficiency of the surface is taken into account.

For example, referring to the tables, the actual cost paid per square foot of surface of a 3-col. 38 in. 10-section steam-type radiator is 1.00 and it omits 228 B.T.U. per square foot per hour, while the actual cost for the same radiator 18 in. high is 1.43 and the heat emission is 252 B.T.U. The cost per square foot actually paid (see vertical figures at bottom of tables) for the radiator 18 in. high is 43% more than for the one 38 in. high, but with the increased heat emission of 10½% taken into account, the relative cost per square foot of the radiator 18 in. high is only (1.43 ÷ 1.105 = 1.29) 29% greater.

As an example of how to select the cheapest radiator, assume a heat loss from a room of 11,250 B.T.U. Glancing over each column of relative costs it will be found that a 2-col. 26 in. 17-section radiator has a relative cost of 1.15 and is cheapest for radiation 26 in. high. If the height is not a limiting factor, then a 1-col., 38 in. 15-section has the lowest rleative cost (R. C. = 0.98) with 2-col., 38 in. 12-section or 3-col., 38 in. 10- section almost as cheap (R. C. = 1.00).

ANALYSIS OF RELATIVE COSTS

If curves of relative costs are made from the data in the tables it will be found that no sweeping statement covering all cases can be made as to which size of radiation is cheapest for the same total heat emission. In general, 3-col., 38 in. steam-type radiation is least expensive in relative cost, 1-col. and 2-col. radiation of the same height being about as cheap and in some cases cheaper. Compared by the number of columns, the actual costs, as well as the relative costs, per square foot of steam-type radiation increase with decrease in height of radiators, with the exception that radiators 45 in. high cost more than those 38 in. high. Compared by height, relative costs (only) increase with increase in number of columns, with the exception that 3-col. steam-type radiators 45 in. high are the cheapest of all. On the other hand, actual costs for any given height of radiation decrease with increase in number of columns, except that 3-col. steam-type radiation is cheapest in all heights.

Actual costs relative to 3-col., 38 in. steam-type radiation for radiators of various heights and number of columns are given in the following table as well as at the bottom of all the accompanying tables. It may be seen from this table that in the case of water-type radiation the costs for 3-col. and 4-col. radiators of equal height are the same.

ACTUAL COSTS OF CAST-IRON COLUMN DIRECT RADIATION.

RELATIVE TO 3-COL. 38-IN. STEAM-TYPE RADIATION AS 1.00.

Steam-Type Radiation For Use In Steam Heating Only.

	Height, Inches.							
	45	38	32	26	23	22	20	18
1-Col.	——	1.08	1.18	1.30	1.36	——	1.48	——
2-Col.	1.10	1.04	1.13	1.25	1.31	——	1.43	——
3-Col.	1.06	1.00	1.09	1.20	——	1.29	——	1.43
*4-Col.	1.09	1.03	1.12	1.24	——	1.33	——	1.47
*2-Col. Hospital	1.20	1.14	1.23	1.36	1.43	——	1.56	——

Water-Type Radiation For Use In Steam or Water Heating.

	Height, Inches.							
	45	38	32	26	23	22	20	18
1-Col.	——	1.12	1.21	1.34	1.40	——	1.53	——
2-Col.	1.13	1.07	1.16	1.28	1.34	——	1.47	——
3-Col.	1.09	1.03	1.12	1.24	——	1.33	——	1.47
4-Col.	1.09	1.03	1.12	1.24	——	1.33	——	1.47
2-Col. Hospital	1.20	1.14	1.23	1.36	1.43	——	1.56	——

	Height, Inches.					
	9 B - 29	7 B - 22	5 A - 13	13	16	20
Wall	1.14	1.14	1.35	——	——	——
Window	——	——	——	1.62	1.53	1.41

*Note.—4-col. hospital, wall and window radiation made in water-type only, but may be used with steam, as well as with water heating. Costs shown at this point for comparison.

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Efficiencies of radiators increase with decrease in height, number of columns and number of sections, under six sections the increase in efficiency and therefore the relative cost being very rapid. The relative cost of 2-col. hospital-type radiation is but little more than that of plain 2-col. radiation, due to the greater efficiency of the former. Wall radiation, though high in actual cost, is by far the cheapest in relative cost as it is highly efficient. It is also a great space saver. Window radiation, although the most expensive, is largely used at present.

Explanation of Abbreviations Used

R.C = Relative cost per square foot, based on heating efficiency with 3-col., 38-in., 10-sec. steam-type radiation as 1.00. Given for each of 1 to 20 sections. Below this, in vertical figures, the cost actually paid where the heating efficiency is not considered. The latter cost is relative to 3-col., 38-in. steam-type radiation taken as 1.00, but unlike the relative cost, it does not vary with the number of sections. To save confusion it is hereafter referred to as actual cost.

E.D.R. = Equivalent direct radiation, based on 241.7 B.T.U. per square foot for 2-col., 38-in., 10-sec. radiator. For example, the rated external surface and the B.T.U. for this radiator are both 40 sq ft., but for a 4-col., 45-in., 4-sec. radiator, the E.D.R. would be 36.47 sq. ft. instead of 40, as the efficiency or B.T.U. per square foot is only 220.

CONVERSION FACTORS FOR OTHER STEAM AND ROOM TEMPERATURES

A table of conversion factors is appended for use in obtaining data for other steam or room temperatures. For example, at 215° F. steam temperature and 70° F. room temperature, a 4-col., 18 in. radiator of 14 sections, or 42 sq. ft. of rated surface, will transmit a total of 10,198 B.T.U. per hour (see table) at a relative cost of 1.39, but 12 sections (36 sq. ft.) of this radiator will give the same heat emission at a steam temperature of 227° (5 lbs. gage) and room temperature of 60°. For example, the proper conversion factor for the latter temperature conditions (0.864), multiplied by 10,198, equals 8811 B.T.U., a total heat emission corresponding to that of the 12-section radiator at the former temperature conditions (see table).

The relative cost at the new temperatures will remain as before (1.38), providing the same radiator is taken as the base at the new temperatures, but if compared with that at the first temperatures, the relative cost drops to $(138 \times 0.864) = 1.19$. This cost may be obtained in another way, thus: 10,198 B.T.U. ÷ 36 sq. ft. = 283 B.T.U., the new efficiency. As this is an increase of 24% over the base of 242 B.T.U., the actual cost paid of 1.47, divided by 1.24, will give a relative cost of 1.19.

This decrease in relative cost shows the economies which may be obtained by increasing either the steam temperature or room temperature. In the

(*Concluded on Page 57*)

Comparative Costs and Heat Emission for C. I. Direct Radiation

Steam Temp. 215° F. Room Temp. 70° F.

No. of Sections	Length	1 Col.						2 Col.						3 Col.							4 Col.					2 Col. Hospital				
		Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam	R.C. Water	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam	R.C. Water	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam	R.C. Water	Length	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam or Water	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam or Water
1	2.5	593	1.5	2.45	395	.86	.88	823	2	3.41	412	.79	.81	878	2.25	3.63	390	.84	.86	3	1125	3	4.65	375	.90	861	2	3.56	431	.83
2	5.0	982	3.0	4.06	327	1.04	1.07	1313	4	5.43	328	.99	1.02	1430	4.50	5.92	318	1.03	1.06	6	1823	6	7.54	304	1.11	1391	4	5.76	348	1.02
3	7.5	1377	4.5	5.70	306	1.11	1.14	1810	6	7.49	302	1.08	1.11	1961	6.75	8.13	291	1.12	1.16	9	2522	9	10.43	280	1.20	1921	6	7.95	320	1.11
4	10.0	1772	6.0	7.33	295	1.15	1.18	2304	8	9.53	288	1.13	1.16	2491	9.00	10.31	277	1.18	1.22	12	3218	12	13.31	268	1.25	2448	8	10.13	306	1.16
5	12.5	2168	7.5	8.97	289	1.17	1.21	2798	10	11.58	280	1.17	1.20	3020	11.25	12.49	268	1.22	1.25	15	3917	15	16.21	261	1.29	2979	10	12.33	298	1.19
6	15.0	2562	9.0	10.60	285	1.19	1.23	3292	12	13.62	274	1.19	1.22	3553	13.50	14.70	263	1.24	1.28	18	4615	18	19.09	256	1.31	3509	12	14.52	292	1.22
7	17.5	2957	10.5	12.23	282	1.20	1.24	3786	14	15.66	270	1.21	1.24	4084	15.75	16.90	259	1.26	1.30	21	5313	21	21.98	253	1.33	4038	14	16.71	288	1.23
8	20.0	3353	12.0	13.87	279	1.21	1.25	4279	16	17.70	267	1.22	1.25	4615	18.00	19.09	256	1.27	1.31	24	6011	24	24.87	251	1.34	4568	16	18.90	286	1.25
9	22.5	3748	13.5	15.51	278	1.22	1.26	4772	18	19.74	265	1.23	1.26	5146	20.25	21.29	254	1.28	1.32	27	6710	27	27.76	249	1.35	5099	18	21.10	283	1.26
10	25.0	4143	15.0	17.14	276	1.23	1.26	5264	20	21.78	263	1.24	1.27	5679	22.50	23.50	252	1.29	1.33	30	7404	30	30.63	247	1.36	5626	20	23.28	281	1.26
11	27.5	4538	16.5	18.78	275	1.23	1.27	5753	22	23.80	262	1.25	1.28	6210	24.75	25.69	251	1.30	1.34	33	8103	33	33.53	246	1.37	6156	22	25.47	280	1.27
12	30.0	4932	18.0	20.41	274	1.24	1.27	6245	24	25.84	260	1.25	1.29	6742	27.00	27.89	250	1.31	1.35	36	8802	36	36.42	245	1.38	6686	24	27.66	279	1.28
13	32.5	5327	19.5	22.04	273	1.24	1.28	6738	26	27.88	259	1.26	1.29	7273	29.25	30.09	249	1.31	1.35	39	9501	39	39.31	244	1.38	7215	26	29.85	278	1.28
14	35.0	5723	21.0	23.68	273	1.24	1.28	7232	28	29.92	258	1.26	1.30	7803	31.50	32.28	248	1.32	1.36	42	10198	42	42.19	243	1.39	7744	28	32.04	277	1.29
15	37.5	6118	22.5	25.31	272	1.25	1.29	7728	30	31.97	258	1.27	1.30	8333	33.75	34.48	247	1.32	1.36	45	10895	45	45.08	242	1.39	8274	30	34.23	276	1.29
16	40.0	6514	24.0	26.95	271	1.25	1.29	8221	32	34.01	257	1.27	1.30	8863	36.00	36.67	246	1.32	1.37	48	11592	48	47.96	242	1.39	8803	32	36.42	275	1.29
17	42.5	6908	25.5	28.58	271	1.25	1.29	8714	34	36.05	256	1.27	1.31	9398	38.25	38.88	246	1.33	1.37	51	12291	51	50.85	241	1.40	9333	34	38.61	275	1.30
18	45.0	7304	27.0	30.22	271	1.25	1.29	9209	36	38.10	256	1.28	1.31	9931	40.50	41.09	245	1.33	1.37	54	12987	54	53.73	241	1.40	9864	36	40.81	274	1.30
19	47.5	7698	28.5	31.85	270	1.25	1.29	9703	38	40.14	255	1.28	1.31	10464	42.75	43.29	245	1.33	1.37	57	13685	57	56.62	240	1.40	10393	38	43.00	274	1.30
20	50.0	8094	30.0	33.49	270	1.26	1.30	10196	40	42.18	255	1.28	1.31	10989	45.00	45.47	244	1.34	1.38	60	14382	60	59.50	240	1.40	10920	40	45.18	273	1.30
		5½" Wide x 20" High				1.48	1.53	8½" Wide x 20" High				1.43	1.47	10" Wide x 18" High				1.43	1.47		11¼" Wide x 18" High				1.47	8½" Wide x 20" High				1.56

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For 18-In. and 20-In. Radiators

Comparative Costs and Heat Emission for C. I. Direct Radiation

Steam Temp. 215° F. Room Temp. 70° F.

No. of Sections	Length	1 Col.						2 Col.						3 Col.						Length	4 Col.					2 Col. Hospital				
		Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam	R.C. Water	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam	R.C. Water	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam	R.C. Water		Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam or Water	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam or Water
1	2.5	654	1.67	2.71	392	.79	.82	967	2.33	4.00	414	.72	.74	1138	3	4.71	379	.78	.81	3	1430	4	5.92	358	.85	998	2.33	4.13	428	.76
2	5.0	1112	3.33	4.60	334	.93	.96	1520	4.67	6.29	326	.92	.94	1816	6	7.51	303	.97	1.00	6	2320	8	9.60	290	1.04	1606	4.67	6.64	344	.95
3	7.5	1555	5.00	6.43	311	1.00	1.03	2093	7.00	8.66	299	1.00	1.03	2496	9	10.33	277	1.06	1.09	9	3211	12	13.29	268	1.13	2213	7.00	9.16	316	1.03
4	10.0	1997	6.67	8.26	300	1.04	1.07	2666	9.33	11.03	286	1.05	1.07	3174	12	13.13	265	1.11	1.14	12	4101	16	16.97	256	1.18	2821	9.33	11.67	302	1.08
5	12.5	2440	8.33	10.10	293	1.06	1.09	3239	11.67	13.40	278	1.07	1.10	3854	15	15.95	257	1.14	1.18	15	4992	20	20.65	250	1.21	3429	11.67	14.19	294	1.11
6	15.0	2882	10.00	11.92	288	1.08	1.11	3809	14.00	15.76	272	1.10	1.13	4532	18	18.75	252	1.17	1.20	18	5882	24	24.34	245	1.24	4036	14.00	16.70	288	1.13
7	17.5	3324	11.67	13.75	285	1.09	1.12	4376	16.33	18.10	268	1.12	1.15	5211	21	21.56	248	1.18	1.22	21	6773	28	28.02	242	1.25	4644	16.33	19.21	284	1.15
8	20.0	3767	13.33	15.59	283	1.10	1.13	4943	18.67	20.45	265	1.13	1.16	5890	24	24.39	245	1.20	1.23	24	7664	32	31.71	240	1.26	5251	18.67	21.73	281	1.16
9	22.5	4209	15.00	17.41	281	1.11	1.14	5510	21.00	22.80	262	1.14	1.17	6569	27	27.18	243	1.21	1.24	27	8554	36	35.39	238	1.27	5859	21.00	24.24	279	1.17
10	25.0	4652	16.67	19.25	279	1.11	1.15	6081	23.33	25.16	261	1.15	1.18	7248	30	29.99	242	1.21	1.25	30	9444	40	39.07	236	1.28	6468	23.33	26.76	277	1.18
11	27.5	5095	18.33	21.08	278	1.12	1.15	6648	25.67	27.51	259	1.15	1.19	7927	33	32.80	240	1.22	1.26	33	10336	44	42.76	235	1.29	7074	25.67	29.27	276	1.18
12	30.0	5538	20.00	22.91	277	1.12	1.16	7213	28.00	29.84	258	1.16	1.19	8608	36	35.61	239	1.23	1.27	36	11227	48	46.45	234	1.29	7683	28.00	31.79	274	1.19
13	32.5	5980	21.67	24.74	276	1.13	1.16	7780	30.33	30.12	256	1.17	1.20	9286	39	38.42	238	1.23	1.27	39	12118	52	50.14	233	1.30	8290	30.33	34.30	273	1.19
14	35.0	6422	23.33	26.57	275	1.13	1.16	8346	32.67	34.53	256	1.17	1.20	9962	42	41.22	237	1.24	1.28	42	13009	56	53.82	232	1.30	8899	32.67	36.82	272	1.20
15	37.5	6865	25.00	28.40	275	1.13	1.17	8897	35.00	36.81	254	1.18	1.21	10643	45	44.03	237	1.24	1.28	45	13896	60	57.49	232	1.31	9506	35.00	39.33	272	1.20
16	40.0	7309	26.67	30.24	274	1.13	1.17	9464	37.33	39.16	254	1.18	1.21	11323	48	46.85	236	1.24	1.28	48	14784	64	61.17	231	1.31	10114	37.33	41.85	271	1.20
17	42.5	7752	28.33	32.07	274	1.14	1.17	10032	39.67	41.51	253	1.18	1.21	12000	51	49.65	235	1.25	1.29	51	15675	68	64.85	231	1.31	10722	39.67	44.36	270	1.21
18	45.0	8193	30.00	33.90	273	1.14	1.17	10601	42.00	43.86	252	1.18	1.21	12679	54	52.46	235	1.25	1.29	54	16567	72	68.54	230	1.32	11327	42.00	46.86	270	1.21
19	47.5	8635	31.67	35.72	273	1.14	1.17	11167	44.33	46.00	252	1.19	1.22	13361	57	55.28	234	1.25	1.29	57	17459	76	72.23	230	1.32	11935	44.33	49.38	269	1.21
20	50.0	9080	33.33	37.57	272	1.14	1.17	11736	46.67	48.56	252	1.19	1.22	14040	60	58.09	234	1.25	1.29	60	18352	80	75.93	229	1.32	12544	46.67	51.90	269	1.21
		5½" Wide x 23" High				1.36	1.40	8½" Wide x 23" High				1.31	1.34	10" Wide x 22" High				1.29	1.33		11¼" Wide x 22" High				1.33	8½" Wide x 23" High				1.43

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For 22-In. and 23-In. Radiators

No. of Sections	Length	1 Col.						2 Col.						3 Col.						Length	4 Col.					2 Col. Hospital				
		Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam	R.C. Water	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam	R.C. Water	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam	R.C. Water		Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam or Water	Total B.T.U. Per Hr.	Rated Surface Sq. Ft.	E.D.R.–Sq. Ft.	B.T.U. Per Sq. Ft.	R.C. Steam or Water
1	2.5	770	2	3.19	385	.77	.79	1100	2.67	4.55	443	.69	.71	1372	3.75	5.68	366	.75	.77	3	1730	5	7.16	346	.82	1128	2.67	4.67	423	.73
2	5.0	1293	4	5.35	323	.92	.94	1736	5.33	7.18	326	.88	.90	2195	7.50	9.08	293	.94	.97	6	2808	10	11.62	281	1.01	1813	5.33	7.50	340	.92
3	7.5	1807	6	7.48	301	.99	1.01	2373	8.00	9.82	297	.96	.99	3017	11.25	12.48	288	1.02	1.05	9	3887	15	16.08	259	1.09	2498	8.00	10.34	312	1.00
4	10.0	2321	8	9.60	290	1.02	1.05	3010	10.67	12.45	282	1.01	1.04	3840	15.00	15.89	256	1.07	1.10	12	4964	20	20.54	248	1.14	3179	10.67	13.15	298	1.04
5	12.5	2835	10	11.73	284	1.05	1.08	3652	13.33	15.11	274	1.04	1.04	4661	18.75	19.28	249	1.10	1.14	15	6043	25	25.00	242	1.17	3864	13.33	15.99	290	1.07
6	15.0	3348	12	13.85	279	1.06	1.10	4289	16.00	17.75	268	1.06	1.04	5485	22.50	22.69	244	1.12	1.16	18	7122	30	29.47	237	1.19	4547	16.00	18.81	284	1.09
7	17.5	3863	14	15.98	276	1.08	1.11	4920	18.67	20.36	264	1.08	1.11	6308	26.25	26.10	240	1.14	1.18	21	8198	35	33.92	234	1.21	5228	18.67	21.63	280	1.11
8	20.0	4377	16	18.11	274	1.09	1.12	5560	21.33	23.00	261	1.09	1.12	7128	30.00	29.49	238	1.15	1.19	24	9276	40	38.38	232	1.22	5913	21.33	24.46	277	1.12
9	22.5	4891	18	20.24	272	1.09	1.13	6197	24.00	25.64	258	1.10	1.13	7952	33.75	32.90	236	1.16	1.20	27	10355	45	42.84	230	1.23	6600	24.00	27.31	275	1.13
10	25.0	5404	20	22.36	270	1.10	1.13	6832	26.67	28.27	256	1.11	1.14	8775	37.50	36.31	234	1.17	1.21	30	11435	50	47.31	229	1.24	7282	26.67	30.13	273	1.14
11	27.5	5918	22	24.48	269	1.10	1.14	7471	29.33	30.91	255	1.12	1.15	9595	41.25	39.70	233	1.18	1.21	33	12513	55	51.77	228	1.24	7966	29.33	32.96	272	1.15
12	30.0	6432	24	26.61	268	1.11	1.14	8109	32.00	33.53	253	1.13	1.16	10418	45.00	43.10	232	1.18	1.22	36	13592	60	56.23	227	1.25	8650	32.00	35.79	270	1.15
13	32.5	6947	26	28.74	267	1.11	1.14	8746	34.67	36.19	252	1.13	1.16	11242	48.75	46.51	231	1.19	1.23	39	14671	65	60.70	226	1.25	9330	34.67	38.60	269	1.16
14	35.0	7459	28	30.86	266	1.11	1.15	9383	37.33	38.82	251	1.14	1.17	12065	52.50	49.92	230	1.19	1.23	42	15750	70	65.16	225	1.26	10016	37.33	41.44	268	1.16
15	37.5	7974	30	32.99	266	1.12	1.15	10020	40.00	41.46	251	1.14	1.17	12889	56.25	53.33	229	1.20	1.23	45	16827	75	69.62	224	1.26	10696	40.00	44.25	267	1.16
16	40.0	8489	32	35.12	265	1.12	1.15	10662	42.67	44.11	250	1.14	1.17	13710	60.00	56.72	229	1.20	1.24	48	17904	80	74.08	224	1.26	11378	42.67	47.07	267	1.17
17	42.5	9000	34	37.24	265	1.12	1.15	11299	45.33	46.75	249	1.15	1.18	14531	63.75	60.12	228	1.20	1.24	51	18981	85	78.53	223	1.27	12062	45.33	49.90	266	1.17
18	45.0	9515	36	39.37	264	1.12	1.15	11933	48.00	49.37	249	1.15	1.18	15353	67.50	63.52	228	1.20	1.24	54	20061	90	83.00	223	1.27	12744	48.00	52.73	266	1.17
19	47.5	10028	38	41.49	264	1.12	1.16	12570	50.67	52.01	248	1.15	1.18	16174	71.25	66.92	227	1.21	1.24	57	21140	95	87.46	223	1.27	13425	50.67	55.54	265	1.17
20	50.0	10544	40	43.62	264	1.13	1.16	13211	53.33	54.68	248	1.15	1.18	16995	75.00	70.31	227	1.21	1.25	60	22220	100	91.93	222	1.27	14111	53.33	58.38	265	1.17
		5½" Wide				1.30	1.34	8½" Wide				1.25	1.28	10" Wide				1.20	1.24		11¼" Wide				1.24	8½" Wide				1.36

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For 26-In. Radiators

Comparative Costs and Heat Emission for C. I. Direct Radiation.

Steam Temp. 215° F. Room Temp. 70° F.

No. of Sections	Length	1 Col.				R.C.		2 Col.				R.C.		3 Col.				R.C.		Length	4 Col.					2 Col. Hospital				
		Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	Steam	Water	Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	Steam	Water	Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	Steam	Water		Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	R.C. Steam or Water	Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	R.C. Steam or Water
1	2.5	952	2.5	3.94	381	.71	.73	1237	3.33	5.18	371	.70	.71	1665	4.5	6.89	370	.67	.69	3	2166	6.5	8.96	334	.77	1391	3.33	5.76	417	.68
2	5.0	1589	5.0	6.57	318	.85	.87	2121	6.67	8.78	318	.81	.83	2635	9.0	10.90	293	.85	.87	6	3513	13.0	14.53	270	.95	2219	6.67	9.18	333	.85
3	7.5	2217	7.5	9.17	296	.91	.94	2903	10.00	12.07	290	.89	.91	3605	13.5	14.92	267	.93	.96	9	4859	19.5	20.10	249	1.03	3051	10.00	12.62	305	92
4	10.0	2845	10.0	11.77	285	.94	.97	3675	13.33	15.20	276	.94	.96	4674	18.0	19.34	260	.95	.99	12	6205	26.0	25.67	239	1.07	3878	13.33	16.04	291	.97
5	12.5	3471	12.5	14.36	278	.97	1.00	4452	16.67	18.42	267	.97	.99	5544	22.5	22.94	246	1.01	1.04	15	7550	32.5	31.24	232	1.10	4710	16.67	19.49	283	1.00
6	15.0	4098	15.0	16.95	273	.98	1.01	5220	20.00	21.60	261	.99	1.01	6512	27.0	26.94	241	1.03	1.06	18	8896	39.0	36.81	228	1.12	5538	20.00	22.91	277	1.02
7	17.5	4725	17.5	19.55	270	.99	1.02	5992	23.33	24.79	257	1.01	1.03	7481	31.5	30.95	238	1.04	1.08	21	10242	45.5	42.37	225	1.14	6369	23.33	26.35	273	1.03
8	20.0	5354	20.0	22.15	268	1.00	1.03	6768	26.67	28.00	254	1.02	1.04	8453	36.0	34.97	235	1.06	1.09	24	11588	52.0	47.94	223	1.15	7196	26.67	29.77	270	1.04
9	22.5	5982	22.5	24.75	266	1.01	1.04	7539	30.00	31.19	251	1.03	1.05	9420	40.5	38.97	233	1.06	1.10	27	12934	58.5	53.55	221	1.16	8025	30.00	33.20	268	1.05
10	25.0	6610	25.0	27.35	264	1.02	1.05	8323	33.33	34.44	250	1.03	1.06	10391	45.0	42.99	231	1.07	1.11	30	14281	65.0	59.09	220	1.16	8856	33.33	36.64	266	1.06
11	27.5	7236	27.5	29.96	263	1.02	1.05	9112	36.67	37.70	249	1.04	1.07	11360	49.5	47.00	230	1.08	1.11	33	15627	71.5	64.65	219	1.17	9684	36.67	40.07	264	1.07
12	30.0	7863	30.0	32.53	262	1.02	1.05	9888	40.00	40.91	247	1.04	1.07	12328	54.0	51.01	228	1.09	1.12	36	16973	78.0	70.22	218	1.18	10512	40.00	43.49	263	1.07
13	32.5	8489	32.5	35.12	261	1.03	1.06	10662	43.33	44.11	246	1.05	1.08	13297	58.5	55.01	227	1.09	1.12	39	18320	84.5	75.80	217	1.18	11341	43.33	46.92	262	1.08
14	35.0	9117	35.0	37.72	261	1.03	1.06	11436	46.67	47.31	245	1.05	1.08	14270	63.0	59.04	227	1.09	1.13	42	19665	91.0	81.36	216	1.18	12169	46.67	50.35	261	1.08
15	37.5	9744	37.5	40.31	260	1.03	1.06	12210	50.00	50.52	244	1.06	1.09	15242	67.5	63.06	226	1.10	1.13	45	21011	97.5	86.93	216	1.19	13000	50.00	53.79	260	1.08
16	40.0	10372	40.0	42.91	259	1.03	1.07	12987	53.33	53.73	244	1.06	1.09	16207	72.0	67.05	225	1.10	1.14	48	22357	104.0	92.50	215	1.19	13829	53.33	57.22	259	1.09
17	42.5	10999	42.5	45.51	259	1.04	1.07	13764	56.67	56.95	243	1.06	1.09	17174	76.5	71.06	225	1.10	1.14	51	23702	110.5	98.06	215	1.19	14658	56.67	60.65	259	1.09
18	45.0	11624	45.0	48.09	258	1.04	1.07	14538	60.00	60.15	242	1.06	1.09	18144	81.0	75.07	224	1.11	1.14	54	25049	117.0	103.64	214	1.19	15486	60.00	64.07	258	1.09
19	42.5	12250	47.5	50.68	258	1.04	1.07	15310	63.33	63.34	242	1.07	1.10	19118	85.5	79.10	224	1.11	1.14	57	26395	123.5	109.21	214	1.20	16314	63.33	67.50	258	1.09
20	50.0	12875	50.0	53.27	258	1.04	1.07	16080	66.67	66.53	241	1.07	1.10	20088	90.0	83.11	223	1.11	1.15	60	27742	130.0	114.78	213	1.20	17142	66.67	70.92	257	1.10
		5½" Wide				1.18	1.21	8½" Wide				1.13	1.16	10" Wide				1.09	1.12		11¼" Wide				1.12	8½" Wide				1.23

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For 32-In. Radiators

No. of Sections	Length	1 Col.				R.C.		2 Col.				R.C.		3 Col.				R.C.		Length	4 Col.					2 Col. Hospital				
		Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	Steam	Water	Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	Steam	Water	Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	Steam	Water		Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	R.C. Steam or Water	Total B.T.U. Per Hr.	Rated Surface Sq.Ft.	E.D.R.–Sq.Ft.	B.T.U. Per Sq.Ft.	R.C. Steam or Water
1	2.5	1125	3	4.65	375	.66	.68	1586	4	6.56	397	.60	.62	1898	5	7.85	380	.60	.62	3	2567	8	10.62	329	.73	1628	4	6.74	407	.64
2	5.0	1849	6	7.65	308	.80	.83	2475	8	10.24	309	.77	.79	2955	10	12.23	296	.77	.80	6	4150	16	17.17	259	.91	2597	8	10.74	325	.80
3	7.5	2578	9	10.67	286	.83	.86	3373	12	13.96	281	.85	.87	4013	15	16.60	268	.85	.88	9	5730	24	23.71	239	.99	3558	12	14.72	297	.87
4	10.0	3307	12	13.68	276	.90	.93	4272	16	17.67	267	.89	.92	5070	20	20.98	254	.90	.93	12	7315	32	30.26	229	1.03	4520	16	18.70	283	.92
5	12.5	4035	15	16.69	269	.92	.95	5172	20	21.40	259	.92	.94	6128	25	25.35	245	.93	.96	15	8900	40	36.82	223	1.06	5480	20	22.67	274	.95
6	15.0	4765	18	19.71	265	.93	.96	6072	24	25.12	253	.94	.97	7185	30	29.73	240	.95	.98	18	10483	48	43.37	218	1.08	6439	24	26.64	268	.97
7	17.5	5494	21	22.73	262	.95	.98	6972	28	28.85	249	.95	.98	8243	35	34.10	236	.97	1.00	21	12069	56	49.93	216	1.09	7400	28	30.62	264	.98
8	20.0	6223	24	25.75	259	.95	.98	7869	32	32.56	246	.97	.99	9300	40	38.48	233	.98	1.01	24	13651	64	56.48	213	1.10	8362	32	34.60	261	.99
9	22.5	6950	27	28.75	257	.96	.99	8766	36	36.27	244	.98	1.00	10358	45	42.85	230	.99	1.02	27	15235	72	63.03	212	1.11	9324	36	38.58	259	1.00
10	25.0	7680	30	31.77	256	.97	1.00	9668	40	40.00	242	.98	1.01	11415	50	47.23	228	1.00	1.03	30	16816	80	69.57	210	1.12	10284	40	42.55	257	1.01
11	27.5	8408	33	34.79	255	.97	1.00	10567	44	43.72	240	.99	1.02	12473	55	51.61	227	1.01	1.04	33	18396	88	76.11	209	1.13	11242	44	46.51	256	1.01
12	30.0	9137	36	37.80	254	.97	1.00	11467	48	47.44	239	1.00	1.02	13530	60	55.98	226	1.01	1.04	36	19978	96	82.66	208	1.13	12206	48	50.50	254	1.02
13	32.5	9867	39	40.82	253	.98	1.01	12367	52	51.17	238	1.00	1.03	14587	65	60.35	224	1.02	1.05	39	21570	104	89.24	207	1.14	13166	52	54.47	253	1.02
14	35.0	10594	42	43.83	252	.98	1.01	13266	56	54.89	237	1.00	1.03	15645	70	64.73	224	1.02	1.05	42	23150	112	95.78	207	1.14	14129	56	58.46	252	1.03
15	37.5	11322	45	46.84	252	.98	1.01	14164	60	58.60	236	1.01	1.03	16703	75	69.11	223	1.03	1.06	45	24732	120	102.33	206	1.14	15084	60	62.41	251	1.03
16	40.0	12053	48	49.87	251	.98	1.01	15062	64	62.32	235	1.01	1.04	17760	80	73.48	222	1.03	1.06	48	26330	128	108.94	206	1.18	16045	64	66.38	251	1.03
17	42.5	12781	51	52.88	251	.99	1.02	15960	68	66.03	235	1.01	1.04	18817	85	77.85	221	1.03	1.06	51	27921	136	115.52	205	1.15	17007	68	70.36	250	1.04
18	45.0	13511	54	55.90	250	.99	1.02	16859	72	69.75	234	1.01	1.04	19872	90	82.22	221	1.03	1.07	54	29506	144	122.08	205	1.15	17971	72	74.35	250	1.04
19	42.5	14239	57	58.91	250	.99	1.02	17758	76	73.47	234	1.02	1.04	20936	95	86.62	220	1.04	1.07	57	31084	152	128.61	205	1.15	18932	76	78.33	249	1.04
20	50.0	14964	60	61.91	249	.99	1.02	18656	80	77.19	233	1.02	1.05	21990	100	90.98	220	1.04	1.07	60	32652	160	135.09	204	1.15	19888	80	82.28	249	1.04
		5½" Wide				1.08	1.12	8½" Wide				1.04	1.07	10" Wide				1.00	1.03		11¼" Wide				1.03	8½" Wide				1.14

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For 38-In. Radiators

Comparative Costs and Heat Emission for C. I. Direct Radiation

Steam Temp. 215° F. Room Temp. 70° F.

No. of Sections	Length	2 Col. Total B.T.U. Per Hr.	2 Col. Rated Surface Sq. Ft.	2 Col. E.D.R.–Sq. Ft.	2 Col. B.T.U. Per Sq. Ft.	2 Col. R.C. Steam	2 Col. R.C. Water	3 Col. Total B.T.U. Per Hr.	3 Col. Rated Surface Sq. Ft.	3 Col. E.D.R.–Sq. Ft.	3 Col. B.T.U. Per Sq. Ft.	3 Col. R.C. Steam	3 Col. R.C. Water	Length	4 Col. Total B.T.U. Per Hr.	4 Col. Rated Surface Sq. Ft.	4 Col. E.D.R.–Sq. Ft.	4 Col. B.T.U. Per Sq. Ft.	4 Col. R.C. Steam or Water	2 Col. Hospital Total B.T.U. Per Hr.	2 Col. Hospital Rated Surface Sq. Ft.	2 Col. Hospital E.D.R.–Sq. Ft.	2 Col. Hospital B.T.U. Per Sq. Ft.	2 Col. Hospital R.C. Steam or Water	No. of Sections
1	2.5	1892	5	7.83	378	.66	.68	2241	6	9.27	374	.65	.67	3	3092	10	12.79	309	.81	1966	5	8.13	393	.70	1
2	5.0	2975	10	12.31	298	.84	.87	3480	12	14.40	290	.83	.86	6	5000	20	20.69	250	1.00	3118	10	12.90	312	.88	2
3	7.5	4059	15	16.79	271	.93	.95	4720	18	19.53	262	.92	.95	9	6909	30	28.59	230	1.08	4271	15	17.67	285	.96	3
4	10.0	5142	20	21.27	257	.98	1.00	5959	24	24.65	248	.97	1.00	12	8816	40	36.47	220	1.13	5424	20	22.44	271	1.01	4
5	12.5	6225	25	25.76	249	1.01	1.04	7197	30	29.78	240	1.01	1.04	15	10725	50	44.37	215	1.16	6575	25	27.20	263	1.04	5
6	15.0	7308	30	30.24	244	1.03	1.06	8435	36	34.90	234	1.03	1.06	18	12636	60	52.28	211	1.18	7725	30	31.96	258	1.06	6
7	17.5	8390	35	34.71	240	1.05	1.08	9677	42	40.04	230	1.05	1.08	21	14539	70	60.15	208	1.20	8875	35	36.72	254	1.08	7
8	20.0	9476	40	39.21	237	1.06	1.09	10915	48	45.16	228	1.06	1.09	24	16445	80	68.04	206	1.20	10028	40	41.49	251	1.09	8
9	22.5	10562	45	43.70	235	1.07	1.10	12155	54	50.29	225	1.07	1.11	27	18360	90	75.96	204	1.22	11183	45	46.27	249	1.10	9
10	25.0	11645	50	48.18	233	1.08	1.11	13392	60	55.41	223	1.08	1.12	30	20270	100	83.86	203	1.23	12335	50	51.03	247	1.11	10
11	27.5	12727	55	52.66	231	1.08	1.11	14632	66	60.54	222	1.09	1.12	33	22176	110	91.75	202	1.23	13487	55	55.80	245	1.12	11
12	30.0	13810	60	57.14	230	1.09	1.12	15872	72	65.67	220	1.09	1.13	36	24084	120	99.64	201	1.24	14640	60	60.57	244	1.12	12
13	32.5	14892	65	61.61	229	1.10	1.13	17113	78	70.80	219	1.10	1.14	39	25987	130	107.52	200	1.24	15789	65	65.32	243	1.13	13
14	35.0	15974	70	66.09	228	1.10	1.13	18354	84	75.94	219	1.10	1.14	42	27902	140	115.44	199	1.25	16940	70	70.09	242	1.13	14
15	37.5	17058	75	70.58	227	1.10	1.13	19593	90	81.06	218	1.11	1.14	45	29805	150	123.31	199	1.25	18090	75	74.84	241	1.14	15
16	40.0	18143	80	75.06	227	1.11	1.14	20832	96	86.19	217	1.11	1.15	48	31712	160	131.20	198	1.26	19248	80	79.64	241	1.14	16
17	42.5	19227	85	79.55	226	1.11	1.14	22068	102	91.30	216	1.11	1.15	51	33626	170	139.12	198	1.26	20400	85	84.40	240	1.14	17
18	45.0	20311	90	84.03	226	1.11	1.14	23306	108	96.43	216	1.12	1.15	54	35537	180	138.75	197	1.26	21551	90	89.16	240	1.14	18
19	47.5	21394	95	88.51	225	1.12	1.15	24544	114	101.55	216	1.12	1.16	57	37430	190	154.86	197	1.26	22705	95	93.94	239	1.15	19
20	50.0	22478	100	93.00	225	1.12	1.15	25776	120	106.64	215	1.12	1.16	60	39340	200	162.76	197	1.27	23850	100	98.68	239	1.15	20
		8½" Wide				1.10	1.13	10" Wide				1.06	1.09		11¼" Wide				1.09	8½" Wide				1.20	

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For 45-In. Radiators

No. of Sections	Wall-5A-13" Total B.T.U. Per Hr.	Wall-5A-13" Rated Surface Sq. Ft.	Wall-5A-13" E.D.R.–Sq. Ft.	Wall-5A-13" B.T.U. Per Sq. Ft.	Wall-5A-13" R.C. Steam-Water	Wall-7B-22" Total B.T.U. Per Hr.	Wall-7B-22" Rated Surface Sq. Ft.	Wall-7B-22" E.D.R.–Sq. Ft.	Wall-7B-22" B.T.U. Per Sq. Ft.	Wall-7B-22" R.C. Steam-Water	Wall-9B-29" Total B.T.U. Per Hr.	Wall-9B-29" Rated Surface Sq. Ft.	Wall-9B-29" E.D.R.–Sq. Ft.	Wall-9B-29" B.T.U. Per Sq. Ft.	Wall-9B-29" R.C. Steam-Water	Length	Window-13" Total B.T.U. Per Hr.	Window-13" Rated Surface Sq. Ft.	Window-13" E.D.R.–Sq. Ft.	Window-13" B.T.U. Per Sq. Ft.	Window-13" R.C. Steam-Water	Window-16" Total B.T.U. Per Hr.	Window-16" Rated Surface Sq. Ft.	Window-16" E.D.R.–Sq. Ft.	Window-16" B.T.U. Per Sq. Ft.	Window-16" R.C. Steam-Water	Window-20" Total B.T.U. Per Hr.	Window-20" Rated Surface Sq. Ft.	Window-20" E.D.R.–Sq. Ft.	Window-20" B.T.U. Per Sq. Ft.	Window-20" R.C. Steam-Water	No. of Sections
1	1658	5	6.86	332	.93	2234	7	9.24	319	.82	2853	9	11.80	317	.82	3	1082	3	4.48	361	1.03	1392	3.75	5.51	355	.99	1708	5	7.07	342	.95	1
2	3208	10	13.27	321	.96	4281	14	17.71	306	.85	5456	18	22.57	303	.86	6	1762	6	7.29	294	1.26	2156	7.50	8.92	288	1.22	2761	10	11.42	276	1.17	2
3	4758	15	19.69	317	.97	6327	21	26.18	301	.86	8059	27	33.34	299	.87	9	2441	9	10.10	271	1.37	2979	14.25	12.33	265	1.32	3816	15	15.79	254	1.27	3
4	6308	20	26.10	315	.98	8372	28	34.64	299	.87	10663	36	44.12	296	.88	12	3119	12	12.90	260	1.42	3803	15.00	15.73	254	1.38	4872	20	20.16	244	1.39	4
5	7860	25	32.52	314	.98	10420	35	43.11	298	.87	13266	45	54.89	295	.88	15	3798	15	15.71	253	1.46	4626	18.75	19.14	247	1.42	5930	25	24.53	237	1.36	5
6	9408	30	38.92	314	.98	12466	42	51.58	297	.88	15869	54	65.66	294	.88	18	4477	18	18.52	249	1.49	5450	22.50	22.55	242	1.44	6987	30	28.91	233	1.39	6
7	10959	35	45.34	313	.98	14513	49	60.05	296	.88	18472	63	76.43	293	.89	21	5156	21	21.33	246	1.51	6274	26.25	25.96	239	1.46	8043	35	33.28	230	1.41	7
8	12508	40	51.75	313	.98	16559	56	68.51	296	.88	21074	72	87.19	293	.89	24	5836	24	24.15	243	1.52	7098	30.00	29.37	237	1.48	9098	40	37.64	227	1.42	8
9	14063	45	58.18	313	.99	18604	63	76.97	295	.88	23676	81	97.96	292	.89	27	6516	27	26.96	241	1.54	7921	33.75	32.77	235	1.49	10152	45	42.00	226	1.43	9
10	15610	50	64.58	312	.99	20650	70	85.44	295	.88	26280	90	108.73	292	.89	30	7194	30	29.76	240	1.54	8745	37.50	36.18	233	1.50	11210	50	46.38	224	1.44	10
11	17610	55	71.00	312	.99	22700	77	93.92	295	.88	28888	99	119.52	292	.89	33	7871	33	32.57	239	1.55	9570	41.25	39.59	232	1.51	12265	55	50.74	223	1.45	11
12	18708	60	77.40	312	.99	24740	84	102.38	295	.88	31493	108	130.30	292	.89	36	8550	36	35.37	238	1.56	10395	45.00	43.01	231	1.51	13320	60	55.11	222	1.45	12
13	20261	65	83.83	312	.99	26790	91	110.86	294	.88	34094	117	141.06	291	.89	39	9227	39	38.18	237	1.56	11217	48.75	46.41	230	1.52	14378	65	58.49	221	1.46	13
14	21812	70	90.24	312	.99	28832	98	119.29	294	.88	36696	126	151.82	291	.89	42	9908	42	40.99	236	1.57	12038	52.50	49.81	229	1.53	15435	70	63.86	221	1.46	14
15	23363	75	96.66	312	.99	30881	105	127.77	294	.88	39299	135	162.59	291	.89	45	10589	45	43.81	235	1.57	12864	56.25	53.22	229	1.53	16490	75	68.23	220	1.47	15
16	24913	80	103.07	311	.99	32928	112	136.23	294	.88	41904	144	173.37	291	.89	48	11266	48	46.61	235	1.58	13686	60.00	56.62	228	1.53	17544	80	72.59	219	1.47	16
17	26461	85	109.48	311	.99	34974	119	144.70	294	.88	44508	153	184.15	291	.89	51	11944	51	49.42	234	1.58	14510	63.75	60.03	228	1.54	18598	85	76.95	219	1.48	17
18	28008	90	115.88	311	.99	37019	126	153.16	294	.89	47110	162	194.91	291	.89	54	12625	54	52.23	234	1.58	15336	67.50	63.45	227	1.54	19656	90	81.32	218	1.48	18
19	29560	95	122.30	311	.99	39062	133	161.16	294	.89	49715	171	205.69	291	.89	57	13304	57	55.04	233	1.59	16160	71.25	66.86	227	1.54	20710	95	85.68	218	1.48	19
20	31110	100	128.71	311	.99	41118	140	170.12	294	.89	52322	180	216.47	291	.89	60	13986	60	57.87	233	1.59	16988	75.00	70.29	227	1.54	21770	100	90.07	218	1.48	20
	17"Wide X 3"Thick				1.35	13"Wide X 3"Thick				1.14	13"Wide X 3"Thick				1.14		12½" Wide				1.62	12½" Wide				1.53	12½" Wide				1.41	

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For Wall and Window Radiators

Progress In The Rating of Heating Boilers

A Comparison of Three Methods, Including That Just Announced by the Chicago Master Steamfitters' Association

In view of the widespread agitation of the subject of heating boiler ratings, it has become a matter of the most timely interest. It is a fact that trade associations in several cities have established their own ratings and the State of Wisconsin now requires boiler manufacturers to furnish other information than the published ratings. In addition to this is the new schedule just put out by the Chicago Master Steamfitters' Association which is, without doubt, one of the most significant steps taken in the boiler rating movement.

IMPARTIAL literature on the subject of rating boilers very generally agrees that when you surround a good fire with surface having water on the other side, some of that surface, in direct opposition, if cooled by a rapid circulation of water, will be very effective, absorbing exceedingly large amounts of heat, as in a water-tube boiler running at 300% or 400% of its rating, the rating of such boilers generally being based on 3,000 B.T.U. absorbed per hour per square foot of heating surface.

In order to exceed the 3,000 B.T.U. rate and maintain efficiency in fuel and reasonably dry steam, however, the heating surface is arranged for high draft resistance with a lofty chimney, and the water is made to scrub the heating surface at great speed, and tremendous areas at the water-line must be provided to permit the steam to detach itself from the water.

Almost any boiler having a fire surrounded by water-cooled surfaces has some wonderfully effective heating surfaces. In order, however, to get the flowing water down to where it can sweep up along these channels, there must of necessity be parts of the boiler which are much cooler, and in order that the products of combustion shall be cooled down to the minimum stack temperature productive of sufficient draft, there must be a great deal of heat-absorbing surface of very much lower heat-absorbing power, than the channels mentioned above.

The impartial observers, therefore, based on many tests of many kinds of boilers, say that, as a general average, no matter how well the boiler may be designed, for efficiency and economy in every day use, the total heat absorbed by a boiler divided by the total heat-absorbing surface in the boiler, ought to give a quotient somewhere between 2000 and 3000. Large power boilers, of course, for this rule must have added to their actual surface that of the economizer and similar auxiliaries.

On the other hand, the heating boiler manufacturers, as a class, say (our literature is full of such statements) that he has found a different sort of anterior and posterior oppositions, and that the rules of procedure developed during many years of scientific research concerning boiled water do not apply to his product. The only way scientifically to rate a heating boiler of his particular type, he states, is by tests in his laboratory. Some of these laboratory rates of output are reached with selected coal and careful attendance, with a new boiler and other ideal conditions, for one manufacturer only recently claimed an average transmission of over 6000 B.T.U. per hour per square foot of heating surface in his cast-iron boiler, at 78% efficiency.

If the boiler is to be of any use, we must have some idea what it will do under average installation conditions, when the coal may be dirty and wet and the chimney may be leaky and low, and the fireman may be a tired soul who cleans the boiler only once in a while and who puts in fuel only when driven to it.

The manufacturers of cast-iron boilers, with two notable exceptions, do not publish heating surface, or fundamental dimensions. Some of them furnish the information when asked.

HOW THE SCHEDULE OF THE CHICAGO MASTER STEAMFITTERS HAS OPERATED

The Chicago Master Steamfitters' Standardization Committee several years ago worked out a schedule, now in effect, which amounts to discounting the published ratings of various manufacturers, based on a rather obscure formula, tempered by experiences of its members. As soon as the committee established a percentage to be added, however, some of the manufacturers commenced to raise the rating of their product, until at present the committee publishes the catalog number and date of each manufacturer's rating, and members of the association are warned, under penalty, against using any ratings of later date than those shown on the committee's schedule.

It is rather troublesome for the heating contractor to select the approved size of any boiler not listed in the published schedule, and any manufacturer who has not arranged to have his product listed in the schedule is at a disadvantage.

RANGE OF THE SCHEDULE

To illustrate the range of the schedule, given a load of 1000 sq. ft. of equivalent direct radiation,

the consumer is compelled to add from 30% to 135% to this sum to arrive at the rating of the boiler, depending on the characteristics of the boiler. For a load of 10,000 sq. ft. of equivalent direct radiation, the additions in fourteen principal classes of boilers run from 20% to 95%.

The manufacturers particularly have complained against the arbitrary rating and the other persons familiar with it, while admitting it is better than nothing, feel that it could be improved from many angles.

FORMULA ON WHICH THE STANDARDIZATION COMMITTEE'S NEW SCHEDULE IS BASED

The Standardization Committee of the Chicago Master Steamfitters' Association has now submitted to the boiler manufacturers a new schedule involving the making of tests by the manufacturers to determine efficiency, the boilers then being rated on the following formula:

$$R = \frac{A \times H \times E}{T \times 240}$$

Where A = 75% of the coal capacity of the boiler with the top of the fuel not closer than 6 in. from the crown sheet. Anthracite coal in pounds at 52.5 lbs. per cubic foot.

H = 13,000 B.T.U. per pound.

E = efficiency of the boiler certified to by the manufacturer and substantiated by official tests under conditions prescribed by the committee, including a chimney schedule having reasonable tolerances.

T = firing intervals. Up to 2000 sq. ft. rating, every 6 hrs.; from 2000 to 9999 sq. ft., every 4 hrs.; 10,000 sq. ft., and over, every 3 hrs.

R = rating of boiler. This is a new rating, presumed to put all makes and kinds and sizes of heating boilers on a parity, and which will permit the committee to designate some simple percentage to be added to the equivalent square feet of radiation in choosing the boiler.

240 = assumed value of a square foot of direct steam radiation.

COMPARISON OF VARIOUS SCHEMES FOR RATING BOILERS

In order to get some idea of what the various schemes for rating heating boilers mean when compared, the accompanying schedule has been made. The information is all published or given freely, except the heating surfaces of two of the boilers listed. These were drawn to scale and every inch of heating surface computed. In this manner the heating surface of two other cast-iron boilers was figured, the data for which were given by the manufacturers. By this checking it was proved that the methods here shown came within 10% or better of being correct.

ANALYSIS OF TABLE

It will be observed in column 5 that boilers were selected rated by their manufacturers at around 10,000 sq. ft.

All of the sectional cast-iron heating boilers listed are as advertised for anthracite coal, without the

Comparison of Boiler Ratings as Given by Manufacturers and as Figured from Chicago Steamfitters' Association's Formula

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Manufacturers			1922 Chgo S. Fitters			1925 Chicago Steamfitters					
No	Sq Ft Grate	Sq. Ft. H.S.	B.T.U. ÷ H.S	Rating	lbs coal ÷ grate	BTU ÷ H.S	Rating	lbs Coal ÷ grate	lbs coal Stored 12"x.75	Eff.	Firing Period	B.T.U. ÷ H.S.	Rating	lbs coal ÷ grate
1	24	780	3200	10400	12.3				952	.65	3	3420	11115	13
2	22.5	617	3800	9800	12.3	2950	7600	9.6	890	.65	3	4000	10400	13
3	25.2	472	5200	10250	11.6	2900	5700	6.4	1000	.65	3	5950	11700	13
4	25.5	954	2520	10000	11.1	2400	8300	9.2	1050	.65	3	2950	11750	13
5	24.7	1089	2200	10000	12.2				975	.65	3	2500	11400	13
6	25.	522	5300	10500	11.9	2700	5900	6.7	985	.65	3	5300	11500	13
7	30.4	390	6250	10100	9.9	3620	5900	5.5	1200	.65	3	8650	14050	13
8	23.1	345	7150	10250	12.6	4400	6300	7.7	913	.65	3	7450	10700	13

ON Basis: 240 B.T.U. = 1 Sq. Ft. Direct Radiation One lb. anthracite = 13000 B.T.U. @ 65% - 8450

Columns 4-7-13 = B.T.U. per hour per ÷ heating surface below water-line.

Columns 6-9-15 = Lbs. coal per hour per Sq. Ft. of grate

Column 10 = Lbs. coal in boiler to cover grate 12" deep

various appliances for smokeless combustion of bituminous coal, and all have the full-size grate surfaces recommended by the makers.

No. 2 boiler is listed to indicate the difficulty to be met with in rating by coal capacity. This boiler has a double grate. Its manufacturers enter credit for both layers of grate, and recommend it for anthracite, as well as for bituminous coal. It seems impracticable to allow for 12 in. depth of fuel on both grates, so, as tabulated, but one layer of grate is counted.

A boiler which has a considerable part of its heating surface above the water-line may, on this account, deliver a better quality of steam, but it is not admitted that such heating surface has a noticeable influence on the volume of output. In most cases with heating boilers the area of steam-liberating surface is reduced in proportion, as the area of heating surface in the steam space is increased.

A boiler which has its water-line below the tops of the flues might make a relatively more satisfactory boiler for heating water than for generating steam.

Column 3 gives the heating surface below the water-line and does not count that in boilers 2, 7 and 8, which projects into the steam space.

Considering columns 4 and 5, a considerable lack of coherency is observed. The boilers are to absorb all the way from 2200 to 7150 B.T.U. per square foot of heat-absorbing surface, although the combustion rates are fairly consistent.

Considering columns 7, 8 and 9, the 1922 Chicago Master Fitters' schedule these are no more coherent or consistent than column 5. It appears that if boiler No. 3, installed in accordance with this schedule, gives good service, then the ratings of boilers Nos. 2 and 4 in column 5 are too low.

The ratings in column 5 and the 1922 schedule do not adequately flatten out the inconsistencies in commercial heating boiler ratings.

APPLICATION OF THE NEW CHICAGO MASTER STEAMFITTERS' SCHEDULE

Considering columns 13, 14 and 15, application of the latest Chicago Master Steamfitters' schedule, it will be observed that 65% has been assumed as the efficiency which all will show at a combustion rate of 13 lbs. per square foot of grate per hour, and with coal 12-in. deep over the grate area. In actual practice, in order to get this efficiency there will doubtless be a great variation in combustion rate, in chimney draft and in depth of fuel. This tabulation, however, treating them all alike, gives a perspective of what the new method of rating proposed will do.

FIRING INTERVALS OF THE NEW SCHEDULE

The volume of coal contained in the boiler certainly has a bearing on the firing intervals, and to this extent we may endorse the 1925 schedule.

Three-hour firing intervals for a 10,000 sq. ft. boiler using anthracite appears too short, but that does not matter seriously if applied to all alike, provided there is a rational discounting factor.

HEATING BOILER DESIGN OF THE FUTURE

The writer believes that the future will see a separate line of boiler patterns for each service, the water-boiler having stream-lined flow-channels and reduced clearances between crown sheet and top; the steam boiler having submerged heating surfaces, greater steam space and disengaging area, and very complete circulation of water below the water-line.

AREAS OF WATER SURFACE IN BOILERS LISTED

The following is a tabulation giving approximate areas of water surface in the boilers listed, with the pounds of steam liberated per hour per square inch of water-line area in each, at atmospheric pressure.

Number	Pounds steam per hour per sq. in. water-line area
1	0.43
2	.68
3	.34
4	.27
5	.34
6	.25
7	.62
8	.78

The volume of a pound of steam at atmospheric pressure is 26.79 cu. ft., while at 50 lbs. pressure it is but 6.75 cu. ft. It appears, therefore, that the higher the operating pressure the slower may be the velocity of the steam when it escapes from the water, and that, with a limited disengaging area, the higher the pressure the drier the steam.

A very large water-tube power boiler running at 200% of normal rating and delivering around 800 H. P. at 125 lbs. pressure, is found to have a disengaging rate of 0.38 lbs. of steam per hour per square inch of water-line area.

There is little published information on this subject, but one may deduce fairly, I think, that in the above tabulation boilers No. 2 and No. 7 and No. 8 have too rapid a rate.

It is the writer's hope that these studies and reflections may contribute toward the invention or development of a method of rating heating boilers which will be fair to all and to which all can agree. It is his belief that all will be unable to agree as to the fairness of any method of rating heating boilers which does not have heating surface as a prominent factor.

The Movement Towards A Standard Radiation Formula

Principal Features of the Rules Compiled by the Heating and Piping Contractors' National Association

IN AN effort to standardize the methods of figuring radiation whereby heating contractors may guarantee to all purchasers of radiation that the surface figured is the correct amount to be provided in a given building, the Heating and Piping Contractors' National Association, about a year ago, compiled a manual entitled "Engineering Standards," containing complete rules, and taking into account, in addition to other items, the matter of air infiltration and the location of the building to be heated. It has been found, for instance, that in some sections the prevailing wind is not from the north, so that the usual exposure factors do not apply, but have to be modified for different localities. So far, the association has prepared standard radiation estimating tables for Birmingham, Boston, Buffalo, Chicago, Cleveland, Denver, Detroit, Kansas City, Los Angeles, Madison, Memphis, Milwaukee, New York, Philadelphia, Pittsburgh, San Francisco, Salt Lake City, St. Louis, St. Paul and Washington.

In developing its formula the Standardization Committee of the association paid particular attention to the various methods of arriving at the air inleakage or air changes in different types of rooms and in rooms of different exposures. It was felt that the tests which had been made were sufficiently reliable to show that the amount of air change in the room was practically not dependent upon the size of the room at all, but on the amount of crack area around and across the window and that leakage or inleakage varied with the type of sash construction. However, there was enough similarity between all the tests that had been made to warrant the assumption of a definite inleakage for each type, and these were incorporated in the committee's calculations.

HOW VELOCITY AND DIRECTION OF WIND AFFECTS RADIATION REQUIRED

In working on air changes due to inleakage the most interesting part of the investigation developed, that is, that the direction and velocity of the wind has a marked effect on the amount of radiation required to heat a building. It was found that one mile of wind velocity was practically equivalent to 1° drop in temperature. In other words, for ease of calculation, a 15-mile wind, with a 15° F. temperature, is equivalent to zero with no wind.

It also developed that all the factors used in calculating radiation, that is, glass and wall and inleakage, were based on a wind factor; that when 1.1 B.T.U. per square foot of glass was used as a factor for single glass, it was the transmission with a 15-mile wind. It is for this reason that the equivalent temperature is often far below zero and, therefore, the exposure factors of from 5 to 50 have been added as a regular thing to take care of the high wind velocities.

When this condition was discovered, it became necessary to find the prevailing temperatures in the various sections of the country, and the prevailing wind directions and wind velocities with these temperatures. One of the interesting facts developed in this connection is that the base temperature we have been accustomed to use, that is 0° F., in most cases is erroneous when it is taken into consideration that all the factors of transmission and infiltration are based upon a 15-mile per hour wind velocity. This factor must be deducted in order to get a true base condition. For instance, Chicago, which has always been figured with a —10° base temperature, under the new method of allowance, has a base temperature of 5° F., and, surprising as it may seem, west is the worst exposure and affects southwest and northwest to the same extent, necessitating the addition of 33 1/3% to wall and glass and infiltration on these points of the compass.

THE HEATING CONTRACTORS' FORMULA

The formula as finally developed by the committee is as follows:

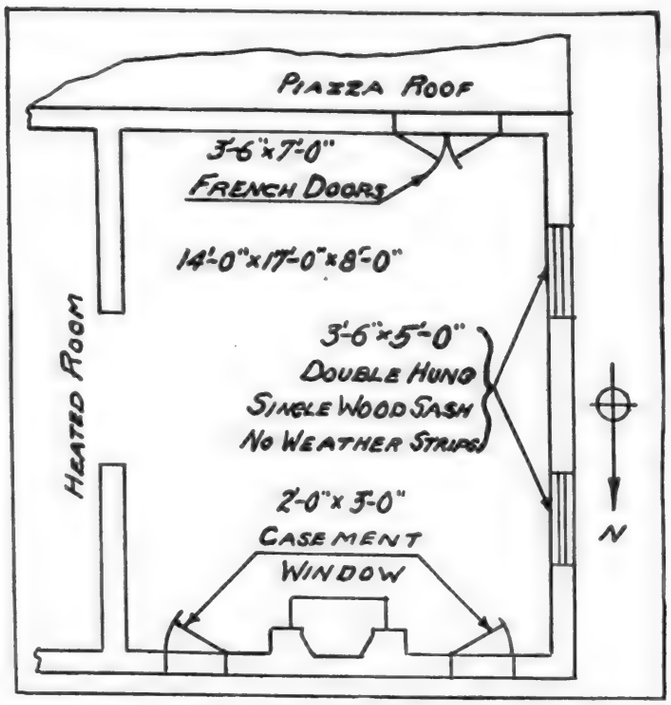
$$\frac{(W + G + I)\ (T_i - T_o)\ E + O\ (T_i - T_a)}{R} =$$

square feet radiation

Where

- W = Net area in square feet of exposed wall × K.
- G = Area in square feet of full frame opening of window or doors × K.
- O = Net area in square feet of roof, floor or any exposure not included above × K.
- I = Lineal feet of window or door crack × infiltration in cubic feet per hour per lineal foot of crack as shown in tables × 0.018.
- K is the coefficient of transmission as shown in the tables for the particular material.
- E is the exposure factor as shown in the tables for the particular locality and direction of exposure.
- T_i is the desired room temperature.
- T_o is the base temperature as shown in the tables for the particular locality.
- T_a is the temperature of adjacent spaces of a different temperature from T_i.
- R is the number of heat units emitted per hour by I sq. ft. of radition as shown in the tables.

To show the application of the formula a plan is given in the Standardization Committee's manual of a second floor room with 8-in. brick wall, furring,



Plan of Room Used in Typical Problem

lath and plaster, also lath and plaster ceiling with unheated roof space above, located in Chicago, Ill.

Heat transmission coefficients are given in the manual for all of the usual types of building construction.

RADIATOR TRANSMISSION FACTORS

Under "Radiator Transmission Factors," for a room temperature of 70° F. and a steam pressure of 1 lb. gauge, and for standard 3-col. 38-in. direct steam radiators, the manual uses a factor of 225 B.T.U. per square foot.

This figure is to be multiplied by the following factors for the equivalent of 3-col. 38-in. radiation of the following types:

Wall coil, 0.75; double wall coil, 0.90; ceiling coil, 1.00; wall radiator, 0.82; double wall radiators, 1.00; wall radiator (ceiling), 1.00.

When indirect steam radiation is used, the surface should be increased 50%, and when direct-indirect steam radiation is used, the surface should be increased 25%.

In open return-line vapor systems, on which thermostatic traps are not used, 10% to 20% additional surface is required in each radiator to act

TABLE 1*

TYPE OF OPENING	Cubic Feet per Hour per Lineal Foot of Crack	Specific Heat of Air	Factor
Double-Hung Wood Sash	50	.018	0.9
Same with Metal Weather Strip	25	.018	0.45
Stationary Wood Sash	25	.018	0.45
Double-Hung Steel Sash	100	.018	1.8
Same with Metal Weather Strip	50	.018	0.9
Fenestra-Type Sash	100	.018	1.8
Casement Windows	100	.018	1.8
Same with Metal Weather Sritp	50	.018	0.9
French Doors	100	.018	1.8
Same with Metal Weather Strip	50	.018	0.9
Outside Doors	200	.018	3.6
Same with Metal Weather Strip	100	.018	1.8
Same with Storm Door	100	.018	1.8
Same with Inner Vestibule Door	100	.018	1.8

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HOW REQUIRED RADIATION WAS DETERMINED IN TYPICAL PROBLEM

NAME	MATERIAL	EXPOSURE	WIDTH (FT)	HEIGHT OR LENGTH (FT)	AREA OR LINEAL FT. CRACK NET	FACTOR	TEMPERATURE DIFFERENCE	NET B.T.U. REQUIRED	EXPOSURE FACTOR	TOTAL B.T.U. REQUIRED	RADIATOR FACTOR	TOTAL RADIATION
GLASS	FRENCH DOOR	S	3½	7	24½	1.1	60°	1617	1.15	1860		
WALL	8" BRICK F. L. AND P.	S	14	8	87½	.27	60°	1418	1.15	1631		
INFILTRATION	FRENCH DOOR	S			28	1.8	60°	3024	1.15	3478		
GLASS	WINDOW	W	6	5	30	1.1	60°	1980	1.33	2640		
WALL	8" BRICK F. L. AND P.	W	17	8	106	.27	60°	1717	1.33	2289		
INFILTRATION	DOUBLE HUNG WINDOW	W			38	.9	60°	2052	1.33	2735		
GLASS	WINDOW	N	6	2	12	1.1	60°	792	1.25	990		
WALL	8" BRICK F. L. AND P.	N	14	8	100	.27	60°	1620	1.25	2025		
INFILTRATION	CASEMENT	N			20	1.8	60°	2160	1.25	2700		
CEILING	L. AND P. AND ROOF SPACE	—	14	17	238	.49	40°	4665	—	4665		
										25013	225	111

NOTE: IF FRENCH DOOR, AND WINDOWS WERE METAL WEATHER STRIPPED THE RADIATION REQUIRED WOULD BE 91ft.

as a condenser and to prevent flow of steam into the return main.

In figuring water radiators, the mean temperature of the water in the radiators should be assumed to be 170° F. Under this condition the amount of water radiating surface is determined by adding 50% to the amount of steam radiating surface figured.

INFILTRATION

To determine the lineal feet of crack for fenestra sash, add the perimeter of the transom or ventilator to the perimeter of the masonry opening. When storm windows are used, not a permanent part of the building, the infiltration, as estimated, may be reduced 50%. Fireplaces without dampers increase infiltration.

The factor in the last column of Table 1 is the number of B.T.U. per lineal foot of crack per hour per degree difference in temperature. This should be multiplied by the total lineal feet of crack to obtain the I used in the radiation formula.

HOW TO USE TABLE

Figure from the plans the number of square feet of wall and glass and lineal feet of crack for each exposure. Find the nearest corresponding quanity in appropriate column. Then read horizontally to extreme left or right hand column for square feet of radiation required. Add additional amount for exposure as shown in upper right hand square of sheet.

For example, for New York City: 70 sq. ft. 12-in. plain brick wall. Reading down the column (plain brick 12 in.) nearest corresponding figure in table is 70.2 and then going horizontally to extreme left or right gives 6 sq. ft. of 38 in. 3-col. radiation. If wall faces north, multiply by 1.50 making 9 sq, ft. actually required.

If same wall has 30 sq. ft. of glass or door, nearest corresponding amount under glass is 30.7 which equals 9 sq. ft. times exposure as above equals 13.5 sq. ft. If window has 39 ft. of crack and is double-hung wood sash without weather strip the amount falls between 37.6 and 41.7, or 9½ sq. ft. of radiation. Multiplying by 1.50 for exposure equals 14¼ sq. ft. of radiation.

The three quantities of radiation 9, 13.5 and 14.25 equal 36.75 or, for simplicity, 37 sq. ft. is the total amount of radiation required for this exposure.

The three quantities for any one exposure can be added together and then multiplied by the exposure factor to obtain the same result. No exposure factor is to be used for roofs, floors, ceilings or partitions or skylights unless skylights are vertical or practically vertical.

Portion of Standard Radiation Estimating Table for New York City as Published in "Engineering Standards"

TEMPERATURE FACTORS		EXPOSURE FACTORS			
Room Temperature	$70° = T_1$	N.	1.50	S.	1.00
Base Temperature	$10° = T_0$	N.E.	1.25	S.W.	1.33
Base Temperature 10° Equivalent to		E.	1.00	W.	1.50
Guarantee Temperature of —5° Outside.		S.E.	1.00	N.W.	1.50

3 Col 38-in. Steam Radiation	GLASS		INFILTRATION			WALLS		
	Window or Door	Sky-Light	Rate per Lineal Foot			Plain Brick		
			25	50	100	8″	12″	
	1.1	1.3	0.45	0.9	1.8	.42	.32	K
225	66.0	78.0	27.0	54.0	108	25.2	19.2	K(Ti-To)
1	3.41	2.89	8.34	4.17	2.08	8.93	11.7	1
2	6.82	5.78	16.7	8.34	4.16	17.9	23.4	2
3	10.2	8.67	25.0	12.5	6.24	26.8	35.1	3
4	13.6	11.6	33.4	16.7	8.32	35.7	46.8	4
5	17.1	14.5	41.7	20.8	10.4	44.7	58.5	5
6	20.5	17.3	50.0	25.0	12.5	53.6	70.2	6
7	23.9	20.2	58.4	29.2	14.6	62.5	81.9	7
8	27.3	23.1	66.7	33.4	16.6	71.4	93.6	8
9	30.7	26.0	75.1	37.6	18.7	80.4	105	9
10	34.1	29.0	83.4	41.7	20.8	89.3	117	10
11	37.6	31.8	91.8	45.9	22.9	98.2	129	11
12	40.9	34.7	100	50.0	25.0	107	140	12
13	44.3	37.6	108	54.2	27.0	116	152	13
14	47.7	40.5	117	58.4	29.1	125	164	14
15	51.2	43.4	125	62.6	31.2	134	176	15
16	54.6	46.2	133	66.7	33.3	143	187	16
17	58.0	49.1	142	70.9	35.4	152	199	17
18	61.4	52.0	150	75.1	37.4	161	211	18

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A Short, Practical Method of Designing Gravity Water Heating Systems

With Six Illustrative Problems Frequently Encountered in Practice, and Their Solutions

By F. E. Giesecke

Professor of Architectural Engineering, University of Texas

VI—The Design of a Two-Pipe System with Overhead Distribution and Reversed Return

Previous articles in this series are as follows: January, 1924, Design of an Elementary Heating System; February, 1924, Design of a Simple Water Heating System; April, 1924, Design of One-Piece System for a Small Building; June, 1924, Design of a Simple Two-Pipe System; August, 1924, Design of Two-Pipe Systems with Direct or Reversed Returns.

LET it be required to design the pipe lines, radiators, and expansion tank of the system shown in Fig. 14. The system is intended for a three-story building having eight radiators on each floor. To simplify the calculation it is assumed that each radiator on the first floor is to dissipate 10,000 B.T.U.; each one on the second floor, 8,000 B.T.U.; and each one on the third floor, 12,000 B.T.U. per hour. It is further assumed that the flow riser and the flow main are insulated and that the cooling of the water in the system, due to heat dissipation by the pipe lines, is so small that it may be neglected in the design.

The centers of the three groups of radiators are to be, respectively, 7 ft., 17 ft., and 27 ft., above the center of the heater. The water is to leave the heater at a temperature of 200° F. The average temperature of the air in the building is to be 70° F.

In order to simplify the illustration as much as possible, a number of elbows and offsets, which are evidently necessary for the correct installation of the system, are not shown in Fig. 14. For instance, there are always a number of offsets and elbows where the flow riser joins the heater, where the return risers join the flow and return mains, where the return main joins the heater and where the radiators are connected to the risers. A number of these have been omitted from the drawing, but all must be included in the calculation. The designing engineer must either have a completely detailed drawing of the proposed installation, or he must be sufficiently familiar with the proposed system so that he can make an accurate estimate of the number of feet of pipe and the number of elbows and other fittings in every section.

WHERE TO BEGIN THE DESIGN

Having all necessary data, we begin the design of the system with that of the circuit of the least-favored radiator. The system has 24 radiators and is divided, by its return risers, into eight sets of three radiators each. The eight sets are alike, and since the system has a reversed return, the eight sets are practically equally favored and we may begin the design with that of any one of the eight sets. In each of the eight sets, the radiator on the first floor is evidently the least favored of the three radiators in the set, because its circuit is practically of the same length as the circuits of the two upper radiators and its elevation above the center of the heater is, relatively, much less than the elevations of the two upper radiators; hence the available pressure-head, per unit length of circuit, is much less for the first floor radiator than for either of the two upper radiators. We may, therefore, begin the design with that of the circuit of any one of the first-floor radiators.

Let us begin with the circuit for Radiator 3; i. e. with Circuit 3. Divide this circuit into 16 sections, as shown in Fig. 14 and in the corresponding table. Record the number of 1000 B.T.U. flowing in each section, and the number of feet of pipe and the number of elbows or elbow equivalents, comprising each section, as shown in the table.

To make an intelligent selection of the "assumed diameter" we will assume that a 2-in. pipe will be the mean of the sizes used in the system and we note, from Diagram II, (see THE HEATING AND VENTILATING MAGAZINE for January, 1924) that, for a 2-in. pipe, the friction in one elbow is about the same as that in 3 ft. of pipe, and then, by placing each elbow equivalent equal to 3 ft. of pipe, we find the equivalent length of Circuit 3 to be 200.87 + 3 x 33, or 300 ft.

If the system is to operate with a temperature drop of 20° F., through the radiator, the pressure-head for Radiator 3 is 7 x 90, or 630 m. i., and the average available pressure-head, per foot of pipe for the first floor radiators is, approximately, 630÷300, or 2.1 m. i.

An inspection of Diagram III (See THE HEATING AND VENTILATING MAGAZINE for April, 1924) shows that the pipe for Sections H-25 and 38-H, which convey 240,000 B.T.U., should be a 5-in. pipe and an inspection of Diagram II shows that the pipe for Sections 26–27 and 30–31, which convey 30,000 B.T.U., should be a 2-in. or a larger pipe. These sizes seem unnecessarily large for so small a system as that under consideration and we will design the system for a temperature drop, through the radiators, of 30° instead of 20°.

We find from Diagram I (See THE HEATING AND VENTILATING MAGAZINE for January, 1924) that,

for temperatures of 200° and 170°, respectively, in the flow and return risers, the pressure-head is 132 m. i. per foot of water column. The pressure-head for Radiator 3 will be 7 x 132, or 924 m. i. and the average available pressure-head per foot of pipe will be, approximately, 924 ÷ 300, or 3.1 m. i.

SELECTING THE ASSUMED DIAMETERS

Remembering now (as fully explained in THE HEATING AND VENTILATING MAGAZINE for January, 1924) that if the temperature drop through the radiator is increased from 20° to 30°, the quantity of water which must flow through the radiator to deliver a given quantity of heat is decreased in the proportion of 30 to 20 and that, in using Diagrams II and III, we must reduce the required number of B.T.U. in the proportion of 30 to 20, in order to find the friction-head due to the corresponding velocity of the water in the system, we may select the "assumed diameters" from Diagrams I and II as follows:

For Section H-25, note from Diagram III that for 160,000 B.T.U. (two-thirds of 240,000 B.T.U.) and 3.1 m. i. friction head, a 4-in. pipe is almost exactly right. Select this size and record it in the table, together with the corresponding friction-heads, to wit: 3 m. i. per foot of pipe and 20 m. i. per elbow.

Having, in this manner, found the "assumed diameter" for every section in the circuit and having recorded the unit friction for every section, we calculate the total friction and find it to be 995 m. i., as shown in the table. This friction-head is about

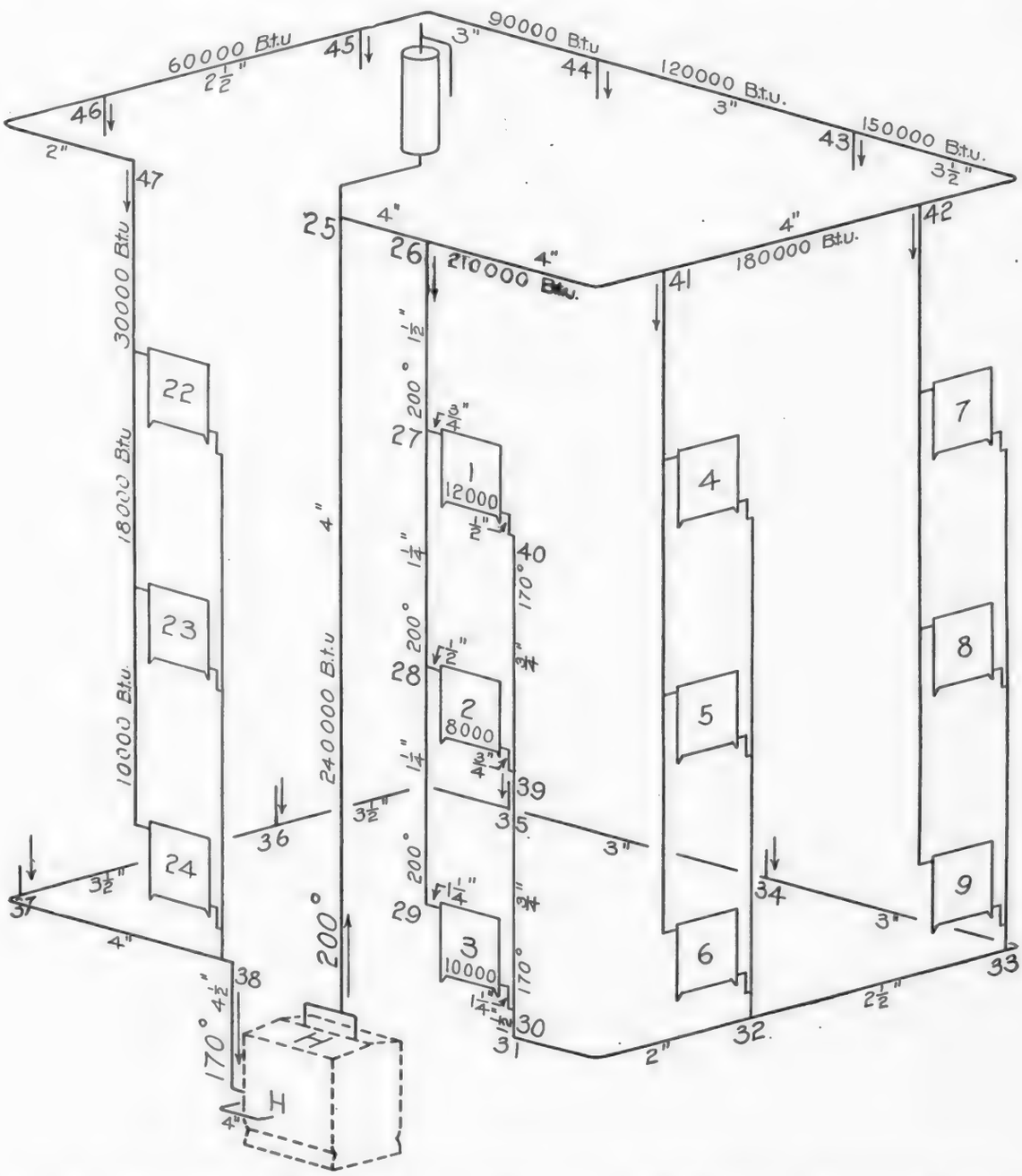

Fig. 14.—Design of a Two-Pipe System with Overhead Distribution and Reversed Return

TABLE FOR CIRCUIT 3

Pressure-head = 7 × 132 = 924 m. i.

Section	1000 B.T.U.	Feet Elbows	Assumed Diameter In.	Unit Friction	Total Friction	Selected Diameter In.	Unit Friction	Total Friction
H–25	240	40 4	 4	3 20	120 80	4		200
25–26	240	5 2	4	3 20	15 40	4		55
26–27	30	12 3	1½	5.6 15.7	67 47	1½		114
27–28	18	10 0	1¼	4.7 0	47	1¼		47
28–29	10	10 0	1¼	1.8 0	18	1¼		18
2 – 3	10	1.2 4.5	1¼	1.8 3.9	2 17	1¼		19
3 –30	10	2.67 7.5	1¼	1.8 3.9	5 29	1¼		34
30–31	30	5 2	1½	5.6 15.7	28 31	1½		59
31–32	30	14 1	 2	1.7 5.4	24 5	 2		29
32–33	60	15 0	2½	2.6 0	39	 2½		39
33–34	90	16 1	 3	1.8 9.0	29 9	 3		38
34–35	120	15 0	 3	3.1 0	47	 3		47
35–36	150	14 1	3½	2.3 13.4	32 13	3½		45
36–37	180	15 0	 3½	3.1 0	47	 3½		47
37–38	210	14 1	 4	2.3 15.7	32 16	 4		48
38–H	240	12 6	 4	3 20	36 120	 4½	1.8 12.5	22 75
Total					995			936

8% larger than the calculated pressure-head; ordinarily we could disregard this difference and select the assumed diameters for the execution of the work. In this case, however, we will secure a better agreement between the calculated pressure and friction-heads by increasing the pipe diameter in one or more of the sections.

An inspection of the table reveals that the principal losses of head occur in the 4-in. pipe of Sections H-25 and 38-H, and in the 1½-in. pipe of Section 26-27. If the pipe of Section 26-27 were increased to a 2-in. pipe, the same change would have to be made in each of the other seven risers, and the larger pipes, exposed to view in the building, would not look well.

It will be better, and probably also cheaper, to substitute a 4½-in. pipe for the 4-in. pipe of Section 38-H, as shown in the table, thereby decreasing the friction head to 936 m. i.; this will be satisfactory since it differs by less than 2% from the calculated pressure-head. It should be noted here that it is not necessary to enlarge the pipe of Section 38-H beyond the tee where the branch connections to the heater meet; the two branches may remain of 4-in. pipe since it is evident, from Diagram III, that the friction-head in a 4-in. pipe conveying 120,000 B.T.U. is considerably less than that in a 4½-in. pipe conveying 240,000 B.T.U.

DESIGN OF CIRCUIT 2

We may now proceed with the design of Circuit 2. This circuit differs from Circuit 3 only by the substitution of Sections 28-2, 2-39, and 39-30 for Sections 28-29, 29-3, and 3-30. Since the pressure-head of Radiator 2 is 10 x 132, or 1320 m. i. larger than that of Radiator 3, it is necessary that the friction-head in Sections 28-2, 2-39, and 39-30 be 1320 m. i. larger than that in Sections 28-29, 29-2, and 2-30. The latter friction-head is, from table for

Circuit 3, 18, 19, 34, or 71 m. i.; the former must be 71 + 1320, or 1391 m. i.

It will not be necessary to make a complete table for Circuit 2 as was done for Circuit 3. It will be sufficient to tabulate the data for the three sections of Circuit 2 which are not also a part of Circuit 3, as follows:

the design of Circuit 2 was based upon the design of Circuit 3.

The pressure-head for Radiator 1 is 1320 m. i. larger than that of Radiator 2, hence the friction-head of Circuit 1 must be 1320 m. i. larger than that of Circuit 2, and since Circuit 1 differs from Circuit 2 only by the substitution of Sections 27-1, 1-40,

TABLE FOR CIRCUIT 2
Pressure-head = 17 × 132 = 2244 m. i.
Available pressure-head for the three sections listed = 1391 m. i.

Section	1000 B.T.U.	Feet Elbows	Assumed Diameter In.	Unit Friction	Total Friction	Selected Diameter In.	Unit Friction	Total Friction
28– 2	8	1.2 5.5	¾	12.5 18.0	15 99	½	50 65	60 356
2–39	8	2.67 7.5	¾	12.5 18.0	33 135	¾		168
39–30	20	10 0	1	21.3	213	¾	75	750
Total					495			1334

For the assumed diameters, the friction-head for the three sections is 495 m. i., and for the entire circuit it is 936 — 71 + 495, or 1360 m. i. This is about 40% less than the available pressure-head and is evidently too small.

For the selected diameters, the friction-head for the circuit is 936 — 71 + 1334, or 2199 m. i. This is only 2% less than the available pressure-head and is satisfactory.

To find the friction-heads for ½-in. pipe and for heat flows smaller than those shown in Diagrams IV and V, the ½-in. pipe lines in those diagrams may be extended beyond the left margins of the diagrams and the friction-heads determined, with sufficient accuracy, by means of a paper scale, divided logarithmically like the lower margins of the diagrams.

DESIGN OF CIRCUIT 1

We may now proceed with the design of Circuit 1 and base its design upon that of Circuit 2, just as

and 40-39 for Sections 27-28, 28-2, and 2-39, the friction-head in the three former sections must be 1320 m. i. larger than that in the latter three; i. e., it must be 1320 + 47 + 416 + 168, or 1951 m. i. The pipe sizes are determined in the usual manner; the results are shown in the following:

For the selected diameters, the friction-head is 936 — 118 + 1879 + 750, or 3447 m. i., which is about 3% less than the available pressure-head and is satisfactory.

HOW TO INTERPRET RESULTS OF CALCULATIONS

In considering the final results of these calculations it should be carefully noted that the pressure-head determinations are based on the assumption that the cooling of the water in the pipe lines, due to the dissipation of heat by the pipes, is negligible and that, consequently, the water will reach the first-floor radiators at the same temperature as that at which it reaches the third-floor radiators. This, of course, is not strictly true. The water in Section

TABLE FOR CIRCUIT 1
Pressure-head = 27 × 132 = 3564 m. i.
Available pressure-head for the three sections listed = 1951 m. i.

Section	1000 B.T.U.	Feet Elbows	Assumed Diameter In.	Unit Friction	Total Friction	Selected Diameter In.	Unit Friction	Total Friction
27– 1	12	1.2 5.5	½	120 150	144 825	¾	30 45	36 248
1–40	12	2.67 6.5	¾	30 45	80 293	½	120 150	320 975
40–39	12	10 0	¾	30	300	¾	30	300
Total					1662			1879

28-29 will be a little cooler than that in Section H-25, and the calculated pressure-head, operating to force the water through Radiator 3, will be augmented by the difference in the pressure due to the water in Sections 29-28, 28-27, and 27-26 and that due to the water in Section H-25.

Similarly, the calculated pressure-heads for Radiators 2 and 1 will be augmented, but not as much as that of Radiator 3. The net result is that the advantage which the two upper radiators have over the lower one is not quite as great as that calculated above.

The method of allowing for this cooling of the water in the flow lines in the design of gravity-flow heating systems will be explained later. In the present case, the writer would suggest that, for an actual installation, the two sections designed with ½-in. pipe be increased to ¾-in. pipe, in order to allow for the cooling of the water in the flow lines. Such slight changes can safely be made because a gravity-flow water heating system possesses a considerable ability to regulate itself.

For example, if the friction-head of Circuit 1 is slightly too small, as compared with those for Circuits 2 and 3, the water will flow more freely through Radiator 1 than through the other two radiators, with the result that the water does not remain in Radiator 1 long enough to have its temperature lowered 30°; this, in turn, reduces the difference in the pressures due to the water columns in Sections 40-39 and 27-28, and, consequently, also the pressure-head for Radiator 1. This reduction in pressure-head partly offsets the error of having the pipe lines of Radiator 1 too large.

DESIGN OF REMAINING PORTIONS OF THE PIPE LINES

We may now proceed with the design of the remaining portions of the pipe lines for the heating system.

Since each of the eight groups of return risers has the same duty to perform, the remaining seven groups may be piped exactly like the first group, designed above. There remain, then, only to be designed, the seven sections of the flow main. We will begin with Section 26-41. It is evident that water, which has arrived at point 26, may flow to point 32 either by flowing through the first group of three radiators or through the second group. Since these two groups of radiators require the same quantity of water and since they are piped alike, the friction-heads in the two groups are equal. If we design Section 26-41 so that its friction-head is equal to the friction-head in Section 31-32, the friction-head in the two possible paths connecting points 26 and 32 will be equal; this is the condition for which Section 26-41 should be designed.

Section 26-41 is composed of 14 ft. of pipe and 1 elbow; it conveys 210,000 B.T.U.; its friction-head is to be 29 m.i. (See Table for Circuit 3, Section 31-32). An inspection of Diagram III shows that (for two-thirds of 210,000 B.T.U.) a 4-in. pipe is too small and a 4½ in. pipe slightly too large. Since Section 25-26 is of 4-in. pipe we will select 4-in. pipe for Section 26-41.

In this manner we proceed with the remaining sections of the flow main, giving each section, as nearly as practicable, the same friction as that in the corresponding section of the reversed return main, and thus find the sizes marked on the pipe diagram of Fig. 14.

DESIGN OF THE RADIATORS

When the radiators are dissipating the maximum quantity of heat, 12,000, 8,000, and 10,000 B.T.U., respectively, the water is to enter the radiators at a temperature of 200° F. and to leave them at a temperature of 170°. We assume that the mean temperature of the water within the radiator is 185°. The mean temperature difference, water to air, is 115°. We find from Fig. 3 (see THE HEATING AND VENTILATING MAGAZINE for February, 1924) that for this temperature difference and for a 3-col., 38-in. radiator, the value of k is 1.32. The heat dissipated by the radiator is 1.32×115, or 152 B.T.U. per square foot; hence the third-floor radiators should have 80, the second-floor radiators, 55, and the first-floor radiators, 65 sq. ft. of surface.

DESIGN OF THE EXPANSION TANK

The object of the expansion tank is to provide storage room for the increase in volume of the water in the system which occurs when the water is heated and also for a small quantity of water with which to replace that which may leak out of the system through faulty joints or imperfect valves.

To determine the size of the expansion tank, we may assume that the tank is to be full when the mean temperature of the water in the system is 180° and half-full when the mean temperature is 70°.

To find the volume of water in the system we will make a fairly accurate calculation of the volume of water in the pipe lines and an approximate determination of the volume in the radiators and in the heater. The lengths and diameters of the pipe lines in the heating system can be secured from the tables for the several circuits. The volume contained in any one pipe can be found by means of Table II (Standard Pipe Dimensions) from which it appears, for example, that 11.31 ft. of 4-in. pipe contain 1 cu. ft. It follows that 101 ft. of 4-in. pipe contain $101 \div 11.31$, or 8.93 cu. ft. of water.

In this way, the data shown in the following table can easily be secured and the volume of water, 22.3 cu. ft., in the pipe lines of the system, determined.

VOLUME OF PIPE LINES

Diameter, inches	Length, feet	Feet per cubic foot	Volume, cu. ft.
4½	8	9.02	0.88
4	101	11.31	8.93
3½	45	14.57	3.09
3	60	19.5	3.08
2½	30	30.1	1.00
2	28	42.91	0.65

1½	136	70.66	1.93
1¼	191	96.25	1.98
¾	191	270.00	0.71
½	30	472.4	0.06
		Total	22.31

To find the volume of water in the radiators, it is sufficiently accurate to assume that, in the ordinary column radiation, there will be 2.5 cu. ft. of water for every 100 sq. ft. of radiation. In the present case there are 1600 sq. ft. of radiation and hence, approximately, 40 cu. ft. of water in the radiators.

To find the volume of water in the heater, it is generally necessary to consult tables issued by the manufacturers. A suitable heater for the present installation would contain about 40 cu. ft. of water.

The volume of water in the system is then, approximately,

In pipe lines	22
In radiators	40
In heater	40
Total	102 cu. ft.

Having determined this volume, we note from Table I (density of water at different temperatures) that the density of water at 70° and 180° is, respectively, 62.30 and 60.58 lbs. per cubic foot and find that the 102 cu. ft. of water at 70° will expand to $102 \times 62.30 \div 60.58$, or 104.9 cu. ft. when heated to 180°. The increase in volume is 2.9 cu. ft. and since the expansion tank is to have twice that capacity, it should be large enough to contain 5.8 cu. ft., or 42 gal. This is the size we will select for the installation.

Since the relations between volume of pipe lines, of radiators, and of heater are similar in similar heating systems, we may note here that a 42-gal. expansion tank was found to be of correct size for a system having 1600 sq. ft. of radiation; i.e., that the ratio was 2.6 gal. per 100 sq. ft. of radiation. This ratio may safely be used to find the size of the expansion tank for any system similar to the one designed here. For systems which differ materially, either in kind or in size, from the one designed here, a special calculation should be made to determine the size of the expansion tank.

In some of the larger central water heating systems, it has been found that an expansion tank is entirely superfluous because the leakage from the system is so great that make-up water must be supplied continuously.

The expansion tank must be connected to the system in such a way that any air, which may accumulate in the system, can readily escape through the expansion tank.

An over-flow line must be provided for the expansion tank and connected in such a way that the water cannot be siphoned out of the expansion tank.

In those localities where very low temperatures may occur, so that the water in the expansion tank or in the pipe leading to the tank might freeze, it is important to have the expansion tank connected to the heating system by means of flow and return risers so that there will, at all times, be sufficient circulation to prevent freezing.

The next section will explain the design of a system having over-head distribution, reversed return, one-pipe return risers, some radiators located below the level of the heater, and other unusual details.

Comparative Costs and Heat Emission For Cast-Iron Direct Radiation

(*Continued from Page* 41)

example giving a saving is made in 6 sq. ft. of radiation or a reduction of approximately 14% ($3.14 at prices of 1923) effected in the actual cost of the radiator. Incidentally, increasing the steam temperature increases the efficiencies and reduces the relative costs more rapidly than reducing the room temperature.

The E.D.R. (equivalent direct radiation) also remains as given in the table (36.42 sq. ft.), unless comparison is made with the original temperatures, in which case it should be divided by 0.864, or the new E.D.R. may be selected direct from the table, thus, 42.19 appears under the heading E.D.R. opposite 10,198 B.T.U.

From what has been said it will be seen that with the exception of the efficiencies the tables can be used without further change for any temperature conditions simply by multiplying the total heat emission by the proper conversion factor. Selection of radiators can also be made direct from the tables whether the final figures of radiation requirements are in B.T.U. losses, square feet of rated surfaces, or square feet of equivalent direct radiation.

It will be noted that the tables are arranged according to height of radiation, rather than by number of columns. This is done because the height of radiators is usually fixed by the height of window sills, so that the number of columns becomes of secondary importance in the selection of the proper radiator. It should also be noted that these tables are based on heat transmission factors of radiation as determined from the experiments of F. B. Rowley and the late John R. Allen. Tabulation of the basic factors (see total B.T.U. per hour in these tables), were originally published in the A.S.H. & V.E. Journal and are given on Standard Heating and Ventilating Data Sheets 13-MM, 13-NN, 13-OO, 13-PP, 13-QQ, 13-RR, 13-SS and 13-TT, as published by THE HEATING AND VENTILATING MAGAZINE.

Wins Prize for Best Paper on Heating Subject

Announcement is made by the (British) Institution of Heating and Ventilating Engineers that the Lumby premium, amounting to $40.00, for the most original contribution on the subject of heating, was awarded to V. Nekrassof, of Philadelphia, Pa. The title of the winning paper was "A Modification of the Hot-Air Box Method in Heat Insulation Tests."

Back To First Principles

Plain Answers to Direct Questions on Present-Day Heating and Ventilating Practice

By T. W. Reynolds

(*Continued from the August issue*)

INCHES of mercury do not indicate the actual pressure, but rather a reduction of pressure below atmospheric pressure. For example, a 20-in. vacuum means one in which the amount of reduction in pressure below atmospheric pressure is equal to the pressure due to the weight of 20 in. of mercury. As 20 in. of mercury gives a pressure of 20×*0.49=9.8 lbs. per square inch below atmospheric pressure, the absolute pressure will be 14.7—9.8=4.9 lbs.

This example is illustrated by Fig. 28. As shown, the pressure of the atmosphere upon the mercury at "A" is opposed by the assumed absolute steam pressure of 4.9 lbs. at "C". This together with the pressure due to the weight of a 20-in. mercury column (4.9+9.8=14.7), counteracts the atmospheric pressure at "A", so that a state of equilibrium is reached.

From this will be clear that the term "inches of vacuum" or "vacuum in inches of mercury" means the inches of mercury column which will be supported in a measuring tube (see "H", Fig. 28) by the difference in pressure between the atmosphere and the pressure (above or below atmosphere) in the space to which the tube is connected.

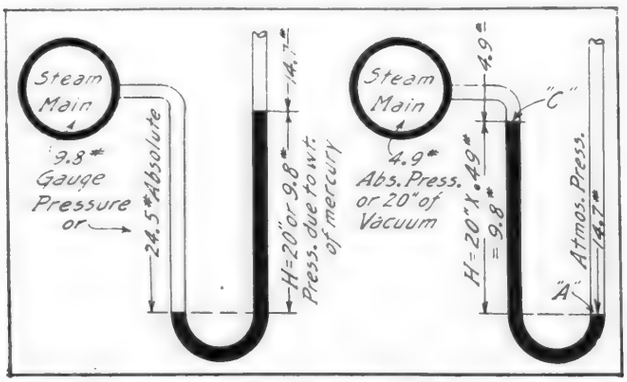

Fig. 28. Showing How Pressures Above or Below Atmospheric Pressure are Measured in a U Tube

It is interesting to observe, in passing, that many of the advantages of the conditions under which we exist and which we commonly take for granted would be lost in a world under vacuum. For example, a siphon would decrease in effectiveness as the vacuum increased and would not work at all in a complete vacuum.

41. Q. Why is it possible to circulate steam under a vacuum when it would seem that the pressure of steam would break a vacuum?

A. Vacuum as applied to steam heating does not mean a space void of matter, but rather the freeing of a heating system or device from air at atmospheric pressure, so that the water in the boiler boiling at a low temperature can circulate as steam throughout the system. A perfect vacuum is a space in which there is no pressure, hence it follows that a partial vacuum is a space in which there is a partial pressure. Therefore, any pressure below atmospheric pressure is spoken of as a vacuum.

Physical laws controlling the relation of pressure to temperature do not change at the pressure point of the atmosphere. Pressure alone determines the temperature of the boiling point of water. Thus, water boils as soon as its expansive or elastic force is equal to the pressure it supports. In a perfect vacuum water will boil at a temperature of 32° F. At the top of mountains the pressure of the atmosphere is less, consequently, the boiling point of water at such points is lower than 212° F.

Tables show this relation between the absolute pressure in pounds per square inch and the boiling point of the water in degrees, Fahr., so when we know the pressure we can learn from the steam tables the temperature, or, if we can measure the temperature, we can tell what the pressure must be.

The following experiment will show that the boiling point lowers with the pressure.

If the water is boiled in a bottle until the steam generated has driven out all of the air and the bottle then corked up, it will be found that cold water poured over the bottle will cause the water to boil again due to the condensation of the steam causing a partial vacuum (partial removal of pressure) above the water.

To make this clearer, suppose the original steam pressure in the bottle was 30 lbs. absolute, then the original temperature would be 219° F., as this is the temperature corresponding to a pressure of 30 lbs. Now if the condensation of the steam, due to the application of the cold water, reduces the pressure to say 5 lbs., the water will be at a higher temperature (219° F.) and contain more heat than the temperature (162° F.) corresponding to its lowered pressure. As a consequence, the water will immediately flash into steam and continue to evaporate until the pressure formed above the water corresponds to the temperature of the boiling point.

The effect of a reduction in pressure is well known in vacuum heating where the condensation from radiators discharges into the returns which are under vacuum. In such cases the condensation is at a higher temperature than the temperature corresponding to the absolute pressure in the return. As a consequence, some of the water changes to steam, or, as we are accustomed to phrase it, "re-evaporation takes place."

From what has been said it will be apparent that atmospheric pressure is the pressure that force

*1 in. of mercury column equals about ½ lb. (0.49 lbs.) pressure below atmosphere.

us to build up an absolute pressure of 14.7 lbs. before steam will flow through the pipes. If we can remove any part of this atmospheric pressure we lower the boiling point. For example, if the pressure is raised in a heating system to just above the pressure of the atmosphere (so as to drive out all of the air) and the steam then shut off, in time the steam will condense and leave a void or vacuum about 1600 times as great as the water condensed. It matters not if the condensation occupies part of the space, the remaining space will still be under a perfect vacuum, providing the condensation has cooled to 32° F. and the system is 100% tight.

Now if the shut-off valve be partially opened, the pressure of the steam admitted into the system will reduce the perfect vacuum (raise the absolute pressure) to some degree of partial vacuum, according to the amount and pressure of the steam admitted. Assuming this amount to be equal to the steam evaporated from 1 cubic inch of water at 212° F., the steam under atmospheric pressure would occupy about 1 cubic foot of space, but as the system is under a perfect vacuum, there is an entire absence of pressure, so that the steam would expand a number of times. However, assuming the amount of steam admitted is sufficient to fill the system, when the steam expands to twice its volume under atmospheric pressure, or, in other words, when the steam is at one half its former tension,* we find in the steam tables, opposite a volume of twice that of the atmospheric pressure, an absolute pressure of about 7 lbs. This corresponds to 16 inches of vacuum, which is the degree of partial vacuum or partial removal of pressure below atmosphere in the system for the conditions assumed. Steam will then circulate in the system at a temperature of this partial vacuum, as well as at lower temperatures and pressures corresponding to higher vacuum as the steam expands into the voids created by its own condensation, but if the rate supplied equals the rate condensed, steam will continue to circulate under 16 inches of vacuum.

Saying that we can have a vacuum, yet fill it with steam, seems an apparent contradiction, but if we view it as a space partially or entirely void of pressure, instead of matter, and into which steam can circulate at the pressure in the space, the matter will be less confusing. The oft-repeated phrase "Nature abhors a vacuum" is applicable not only to a perfect vacuum, but also to a partial vacuum. The first is an entire reduction of pressure, the second a partial reduction, each below atmospheric pressure; so that in each case air tends to rush in to equalize the pressure with that of the atmosphere.

COMBINATION CORNER AND RETURN-BEND PIPE COIL THAT CAUSED TROUBLE

42. *What is wrong with a hot water pipe coil when all radiating surfaces in the house get hot in season except that one and when venting it at the air valve fails to remedy the trouble?*

In an investigation of a typical condition of this kind (a pipe coil on the sun porch of a residence) the connections at the coil were found to be properly piped and pitched, so that at first glance everything appeared satisfactory. However, though the flow and the coil itself were of 1 in. pipe, the return was only ¾ in.

This reduction in pipe size had been made in order to cut expenses, for it had been reasoned by the party who did this work that the return water being colder, must contract, and the pipe size could very well be reduced, no account, however, being taken of the fact that the decrease in volume due to contraction was negligible and not enough to warrant any change in pipe size.

Again, this pipe coil was of the return-bend type, nevertheless it was turned around a corner (See Fig. 29), thereby introducing additional resistance because of the extra elbows over that necessary to the assembly of this type of coil. Some provision of course must be made in all pipe coils for expansion and contraction, this being usually done by turning the coil around a corner or up the wall, but when a doorway interferes or there is no space on the wall, then it is necessary to use a straight coil in which the expansion is taken care of by means of return-bend fittings.

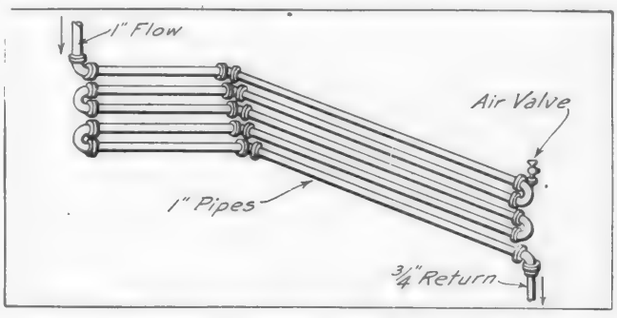

Fig 29. Combination Corner and Return Bend Pipe Coil Which Caused Trouble

This is the only possible excuse for using the return-bend type of coil as such coils are liable to air bind at the bends and the numerous bends and long travel which the water must take from inlet to outlet introduce considerable friction. This seriously reduces the motive head producing circulation (as in the case cited), especially where the pipes of the coil are only 1 in. in size, because such pipe has a large amount of inside perimeter or friction surface in proportion to the volume of water flowing over such surfaces. A coil with 1½-in. or 2-in. pipes would have been better, or, better still, a coil of the miter type (corner coil). Substituting a radiator for the pipe coil would have been best of all, as the circulation to this point was sluggish.

(To be continued)

*The pressure tending to expand it beyond the limits of its confinement.

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IN RESPONSE to a widespread demand and to fill a long-felt want, THE HEATING AND VENTILATING MAGAZINE takes pleasure in announcing a special home-study course in gravity steam and water heating. The course is designed for the benefit of our readers and instruction will be available only to subscribers of THE HEATING AND VENTILATING MAGAZINE. There will be about 35 installments, one appearing in each number, beginning with the November issue.

The decision to inaugurate this special home-study course has been taken after a careful survey of the field made it evident that the average young man entering the heating and ventilating profession is limited in his opportunities to acquire a working knowledge of the fundamentals of this branch of engineering. While a number of educational institutions are conducting heating and ventilating courses, the fact remains that, outside of a few centers, it is well-nigh impossible for our young men to procure an adequate training in their chosen field. The result is that they start at whatever point they have reached through their more or less limited education and trust to their opportunities to pick up the data they still need to make them experts in their line. Needless to say, many of them never rise above a certain level. This, however, is not due as a usual thing to lack of ambition, but, we are convinced, to lack of opportunity to acquire the "inside dope," as it is familiarly termed, which is characteristic of any specialized branch of technical work.

This is not the first time a course of instruction has been offered in heating and ventilating engineering. We are satisfied, however, that the course which has now been laid out will go far towards supplying the information which the young engineer, and, in many cases, his elders most need but which hitherto has not been available in a form which they could readily understand. That the course is to be practical goes without saying. While it is intended primarily for the man who has already begun his career in the drafting or estimating room, it offers the young college graduate the opportunity to secure intensified application of the fundamentals of his chosen profession. As regards the subjects covered and the opportunities offered to obtain answers, criticism of individual solutions of problems and assistance needed for mastering personal difficulties, the course is designed to be of the greatest possible helpfulness to men of widely-varying capabilities.

Full details of the plan of instruction will appear next month. It is sufficient, at this time, to say that each installment published in THE HEATING AND VENTILATING MAGAZINE will proceed in logical sequence, beginning with the simple application of fundamentals and progressing by well-defined steps to the everyday and complex problems in gravity steam and water heating. All necessary information pertaining to the subject in hand will be included in the form of data, tables, sketches, line drawings, floor plans and computing and estimating forms. The entire work is so systematized for presentation, solution, review and correction that those who enroll are not only taught to design and estimate correctly but must do so in a manner calculated to be of the greatest benefit when applied to actual work. The course is a work course and not alone a reading course. All students who enroll will be supplied with application problems to be solved as and when directed in the installment. These problems will constitute a test for the student of his grasp of the subject. They will be carefully examined, checked and criticised and the student will be given a personal correction review showing in detail how fully or how inadequately, as the case may be, he has solved the problem.

The course as it will appear has been prepared by the A-Em-Dee Engineering Company, of Washington, D. C. After a student has enrolled, all of the instruction, outside of the text published in THE HEATING AND VENTILATING MAGAZINE, will be handled directly by this company. In other words, THE HEATING AND VENTILATING MAGAZINE is serving as the channel through which our readers may acquire and apply the necessary knowledge of the fundamentals of modern heating practice.

Will it pay? It is worth-while? These are questions our readers must answer for themselves. We will say this, however, that after an inspection of the lessons and from our knowledge of the men who have prepared them, we are prepared to recommend the course as one which fills to a remarkable degree the needs of a host of men in the heating profession.

E. Vernon Hill

Who's Who In Heating and Ventilation

IV–E. Vernon Hill

DR. E. Vernon Hill enjoys the distinction of being the only physician ever honored by election to the presidency of the American Society of Heating and Ventilating Engineers. He was chosen for that office at the annual meeting of the society, in New York, in January, 1920.

In his inaugural address at that time, he called attention to certain meaningless or misleading words and expressions commonly used in the literature on ventilation and strongly urged that they be relegated to the limbo of forgotten things, along with obsolete and antiquated apparatus and ancient engineering practice. He particularly denounced the expression "fresh air" as worn out and undesirable on the ground that no two persons have the same conception of "freshness" when applied to air. The term "foul air" also came in for a liberal portion of his denunciatory remarks, as being indiscriminately applied to air that is excessively warm, humid, lacking in motion, or contaminated by some substance causing perceptible or objectionable odors. Even the word "ventilation," due to its derivation and to its association with antiquated conceptions, was, Dr. Hill stated, an undesirable term to use. He suggested the word "aerology" in its place and explained why the new term was more appropriate and fitting for the new science.

Following his inaugural speech and at subsequent times during the meeting he was addressed, perhaps in a spirit of humor, as the "noted aerologist" and the name stuck, probably without serious objections on the part of the doctor.

EARLY CAREER

Dr. Hill was born in Jamestown, Pa., in the late 70's. His parents moved to Andover, O., about six years after he was born and his early life was spent and schooling was obtained in this small Ohio town. He was graduated from high school at the age of 17 and immediately went to work in the Engineering Department of the Lake Shore and Michigan Southern Railroad. Dr. Hill's father was a superintendent in the Engineering Service of the railroad and the young man's early experience, as well as his inclinations and tendencies, were along engineering lines. During his term of high school and for several years following he maintained a small private chemical laboratory, having a strong inclination in this direction.

TAKES UP INDUSTRIAL CHEMISTRY

In 1899 he decided to take up seriously the study of industrial chemistry and went to Chicago and matriculated at the Chicago University the following winter. He carried letters of introduction to an eminent divine in the Theological Department and was for this reason thrown into contact with

the ecclesiastical, rather than the scientific, part of the institution. His work in the class-room was interesting but his associations outside evidently not what he expected as representative of college life. Having occasion to call upon the late Walter S. Haines, who occupied the chair of chemistry and toxicology at Rush Medical College, he visited that institution some weeks subsequent to his matriculation. The old college building on Harrison Street with the deep hollows worn in the stone steps by the embryo medics of over half a century, their bulldog pipes and somewhat careless language, evidently made a stronger appeal than the modern buildings and more gentlemanly conduct of his associates on the Midway, as he immediately transferred his matriculation to the older institution.

DR. HILL'S MEDICAL PRACTICE

Dr. Hill was graduated from Rush Medical College in 1903, and the following spring opened an office and engaged in the practice of medicine and surgery in Chicago. Probably his first year was much the same as that of other young physicians; patients were not numerous or the fees opulent and he therefore tried, and successfully passed, a Civil Service examination for sanitary inspector in the Department of Health, entering the city service in June, 1904. At that time municipal service was not as exacting as it has become in recent years and an industrious and energetic inspector could make a good showing on his report card and keep his field work well in hand with about two hours activity each day. This allowed ample time for the physicians in the service to take care of their few patients, in addition to their departmental work. During this period, from 1904 to 1912, Dr. Hill followed the practice of medicine and carried on his work in the city service. It was during this time that he became interested in the subject of ventilation.

FIRST WORK IN FIELD OF VENTILATION

In 1905 Dr. Hill and Dr. Enright were assigned to make a sanitary survey of the Chicago schools. The principal part of the work was a study of the ventilating equipment, its design, operation conditions and general efficiency. The Chicago schools, about 300 in number, represented practically every type of apparatus known at that time. Many were with window ventilation only, a few with gravity systems, with direct and direct-indirect heating arrangements. Cone fans were very commonly used. The old Waters system was frequently encountered and a few electrically-operated temperature-control systems of the early Johnson design. The study extended over a period of approximately two years and complete reports, with scale drawings, were submitted for each school. Following the survey, recommendations were made and orders issued for changes in the apparatus or in the operating methods as conditions seemed to warrant. A considerable amount of test work was also undertaken with a view of determining what the actual air conditions were in the different buildings. This practical experience in ventilation aroused an interest in the subject which has continued and increased through all subsequent years.

APPOINTMENT AS HEAD OF CHICAGO DIVISION OF VENTILATION

In 1910 Dr. W. A. Evans, a sanitarian of national reputation, was health commissioner of Chicago. At this time the epoch-making work of Flügge in Germany, Leonard Hill in England and others, was beginning to be generally discussed by ventilating engineers and health officials. Old standards were being questioned and ventilation practice of the time severely criticized. Dr. Evans, realizing that conditions and opinions were rapidly changing, went before the City Council and secured an appropriation for the establishment of a Division of Ventilation in his department—the first such division to be organized in the United States. A Civil Service examination was held in 1912 for chief of the new division and Dr. Hill passed this examination at the head of the list, in competition with about fifteen heating and ventilating engineers from Chicago and other cities. The chief of the bureau at the time did not disguise the fact that he was somewhat disappointed with the selection of a physician instead of an engineer by the Civil Service Board, preferring any of several applicants whose names are now well-known to the heating and ventilating fraternity. Nevertheless, Dr. Hill was duly certified and his efficient work soon dispelled the opposition of his superior.

LACK OF STANDARD TESTING METHODS AND SUITABLE INSTRUMENTS

In taking up the work of organizing the new division he soon found that there were no standard methods of making tests and in many cases no instruments available, except cumbersome laboratory apparatus entirely unsuited for field work. Furthermore, there were no air conditions that were standard and no possibility of comparisons, except the personal opinion of the observer. He immediately set to work designing card records of test data for theatres, street cars, schools, etc., which have been published from time to time in THE HEATING AND VENTILATING MAGAZINE and in Proceedings of the American Society of Heating and Ventilating Engineers. It was necessary to design field instruments and apparatus which were portable, accurate and which could be used to advantage by the more or less untrained personnel of the inspection force. Out of numerous designs and frequent failures many instruments were developed that are regarded as much superior to the older types, and some entirely new apparatus for dust counting, for studying air current, etc., have been added to the armentarium of the engineer.

In developing apparatus and test methods the lack of definite standards was from the first a serious handicap. The enforcement of ventilation laws was difficult, as practically every one coming within the jurisdiction of the department had strong personal opinions as to desirable and efficient ventilation methods.

THE SYNTHETIC AIR CHART

In 1917 Dr. Hill offered his first Synthetic Air Chart to the American Society of Heating and Ventilating Engineers, and it is in connection with this work, probably more than any other, that he is best known. The Synthetic Air Chart, or "Ventilation Yard Stick," as it has been termed, is a chart method of recording complete test data in such a way that a final percentage of perfect is mathematically obtained and the efficiency of the apparatus as a whole, or the air conditions of the room tested, removed from the field of personal opinion or guesswork. Where the final percentage is low the chart also shows which factors are at fault and consequently indicates how conditions can be improved. The Synthetic Air Chart was adopted as its standard by the American Society of Heating and Ventilating Engineers in 1920 and will form the basis for the new Code on Minimum Ventilation Requirements, now under preparation. The chart, with the accompanying description of test methods, has been reprinted by R. Grierson, of the Institution of Heating and Ventilating Engineers, in England, and distributed to that society. It has also been translated into Japanese by the engineering department of the University of Tokio.

Perhaps the most ingenious feature of the Synthetic Air Chart and also the part requiring a considerable amount of study and experimental work is in the first column which brings out the relation between temperature, humidity and air motion in such a way that the variations of different combinations from the ideal can be measured and plotted. When Dr. Hill first published the chart he described in detail how the values in the first column were determined and the nature of the experimental work on which it is based. He stated at the time that the facilities and apparatus available were somewhat crude and that the results were only approximate and therefore urged upon the society on several occasions the necessity for carefully checking and correcting the comfort curves. It was due largely to Dr. Hill's pioneer efforts that the Research Laboratory finally undertook the experimental work which has resulted in establishing the comfort zone and the effective temperature lines, by far the most important research work sub-

mitted to the society by the laboratory up to the present time.

THE HILL PSYCHROMETRIC CHART

In 1920 Dr. Hill first published his Psychrometric Chart which is arranged in the form of an isosceles triangle. It differs from previous charts in that all psychrometric data are tabulated in their proper places on the sides of the triangle, materially simplifying and popularizing the use of psychrometric data.

APPOINTED ACTING CHIEF OF CHICAGO BUREAU OF SANITATION

In 1920 Dr. Hill was appointed acting chief of the Bureau of Sanitation. This included the Division of Ventilation, Division of Plumbing, Smoke Inspection and of Sanitary Inspection. He served in this capacity until 1922 when he resigned to take up engineering and aerological test work under the name of the E. Vernon Hill Company, in which he is engaged at the present time, specializing in tests of schools and public buildings and in the design of ventilating and refrigerating installations for theatre buildings. A recent installation under his direction is the McVicker's Theatre of Chicago, using refrigeration. It is unique in that the temperature in the highest seats in the balcony is maintained *two degress lower* than the seats in the orchestra circle.

Dr. Hill's constant efforts and his almost continuous contributions to heating and ventilating literature during the past 15 years entitle him to high rank among those who have been instrumental in placing the science of ventilation where it is to-day, but, as might be expected, his greatest pride is not in the achievements outlined in this synopsis of his career, but rather in his ability as a metal craftsman.

In his development of a new dust counter with which it is possible to observe the deposit of dust under high magnification as the sample is being taken, the first complete instrument, as well as the folding microscope, are examples of his handiwork.

Dr. Hill was formerly a member of the Chicago Medical Society and the American Medical Association but in recent years has found it necessary to drop these connections as the time given to engineering and engineering society work has crowded out all other professional interests. He served as president of the Chicago Commission on Ventilation in 1918 and also as president of the Chicago Chapter of the American Association of Engineers. He was elected president of the Chicago Chapter of the American Society of Heating and Ventilating Engineers in 1916 and as already stated, president of the national body in 1920. He is also a member of the Chicago Association of Consulting Engineers and of the Chicago Engineers' Club.

President Frank A. Merrill on the Heating Boiler Rating Movement

Further impetus to the movement for the revision of the prevailing methods of rating heating boilers is given by President Frank A. Merrill of the Heating and Piping Contractors' National Association in an article appearing in the current issue of the association's *Official Bulletin*.

After announcing the appointment of a committee consisting of George M. Getschow, of Chicago, chairman; M. L. Crowell, Cleveland, O., J. H. Hicks, of St. Louis; W. L. Fleisher, New York; and Frank A. Merrill, Boston (ex-officio) to co-operate with similar committees appointed by the National Boiler and Radiator Manufacturers' Association and the American Society of Heating and Ventilating Engineers, President Merrill states:

"A resolution passed by the convention clearly shows that the Heating and Piping Contractors' National Association expects this committee to co-operate with similar committees appointed by the National Boiler and Radiator Manufacturers' Association and the American Society of Heating and Ventilating Engineers."

"For twenty years," states Mr. Merrill, "the trade has been actually suffering for a dependable and stable boiler rating, and for twenty years the ratings have been up and down, sometimes the change has been as sudden and terrific as the noted Bay of Fundy tide. If the ratings were all too low the damage would have been far less to the contractor, but commercial advantages generally appeared in the opposite direction causing the boiler with the big rating to look cheap to the layman. This pernicious practice invaded not only the business of our members but of every heating contractor in the country, large and small.

"Where boilers have been installed with a greater rating than they could carry serious financial loss has often resulted to the members of our craft and great annoyance to our customers prior to and during the replacement of the boiler. In many instances it has led to an unhappy debate between the manufacturer and the contractor. In some cases it has resulted in a lost reputation where the work has been very meritorious but the boiler rating led to a disaster."

"Our program" states Mr. Merrill, "contemplates a solution to this heretofore intolerable condition and is an invaluable service to our citizens, and to all branches interested in satisfactory heating installations."

President Merrill called attention to the fact that years have been required to bring this question to a satisfactory close. Twenty years ago the need for revision was felt. Yet it is only at this time that anything definite has been accomplished.

"The question will naturally arise" he continues, "as to why it has taken so long to bring it about. The reasons are obvious to those who have worked on it for so long a time. A successful solution must have the combined support and sanction of a large majority of those directly affected. One or two manufacturers or contractors or engineers could make no headway on the problem by themselves. It takes concerted action for a job of this size and then the action must be taken by organizations large enough to make their influence felt and the various influences correlated into an effective machine."

"To those who believe in procuring an honest and dependable boiler rating and feel that the procuring of such will be a lasting benefit to them and to the public they serve," concludes Mr. Merrill, "we wish to say that in no other way can you so materially assist us in this work as by joining the Heating and Piping Contractors' National Association and bearing your small part of the expense and time necessary for it solution."

Announcing
A Special Home-Study Course in Gravity Steam and Water Heating for readers of The Heating and Ventilating Magazine

Arrangements have been completed with the A-Em-Dee Engineering Company, of Washington, D. C., for the publication in serial form in THE HEATING AND VENTILATING MAGAZINE, beginning with the November issue, of a complete course of instruction in Gravity Steam and Water Heating. The course will comprise about 35 lessons and will embrace every detail of present-day practice in this important branch of engineering.

This course has been prepared especially for the benefit of our readers and instruction will be available only to subscribers of THE HEATING AND VENTILATING MAGAZINE. Every reader who is looking for advancement in his chosen field will now have the opportunity to perfect his knowledge of the principles and practice involved in Gravity Steam and Water Heating.

Watch the November issue for further details.

An Early Scheme for Heating and Ventilating the U. S. Capitol

A copy of Frank Leslie's Illustrated Newspaper for December 31, 1881, which has recently come to light, shows the method adopted at that time for heating and ventilating the Senate Wing of the U. S. Capitol. In view of the present advances in the art more than ordinary interest attaches to the details of the scheme, especially that for moistening the air.

In connection with the sectional elevation, the account states that it shows the improvements in the ventilation of the Senate Chamber from 1869 to 1873. The principal improvements made from 1873 to 1879, not shown on this diagram, are stated to be:

1874: Main and branch air ducts enlarged to increase the supply of air, at a low velocity.

1876: New floor in chamber, resting on iron columns, all brickwork removed from under old floor, and the space converted into a large distributing chamber for equalizing the temperature, and additional registers introduced in new floor for the diffusion of air.

1878: Large air shafts introduced in the side and end walls of the chamber, leading from the coat-rooms and lobby into the loft, above the ceiling of the chamber, for the removal of impure air by the exhaust fans.

Here is how the installation is described in Frank Leslie's Illustrated Newspaper:

"Year after year complaints against the air in the Senate Chamber and Hall of the Representatives increase, and year after year science is invoked to overcome or ameliorate the defects in the early construction. Just how thorough this work has been done may be seen by referring to the diagram of a sectional elevation of the Senate wing of the Capitol. The apparatus for warming and purifying the air is very simple. Fresh air passes from the Western Park into the fan-room where an enormous fan forces it between steam coils into what is called the main air-duct. A spray of water moistens the air, and thence it is allowed to ascend to the air-chamber constructed beneath the floor of the Senate Chamber. During the Summer of 1873 a new air-duct for independent ventilation of the galleries was constructed from the moistening-room to the space beneath the gallery-seats on the left while for the opposite side the air passes direct from the main floor air-chamber. The air then passes through the ventilators in the ceiling, and the products of the gas from 966 burners, used during night sessions, is removed by fans in the exhausting-room, which is on a level with the fan-room. The shaft for the descent of the air is close to that for the ascent, and after the impure air has passed through the exhausting room, it escapes by means of an enormous shaft running to the roof of the wing. The improvements shown in the diagram were recommended by H. F. Hayden, Chief Engineer of the United States Senate, and introduced by Edward Clark, Architect, in accordance with various provisions of Congress."

The principal notations on the illustrations are as follows:

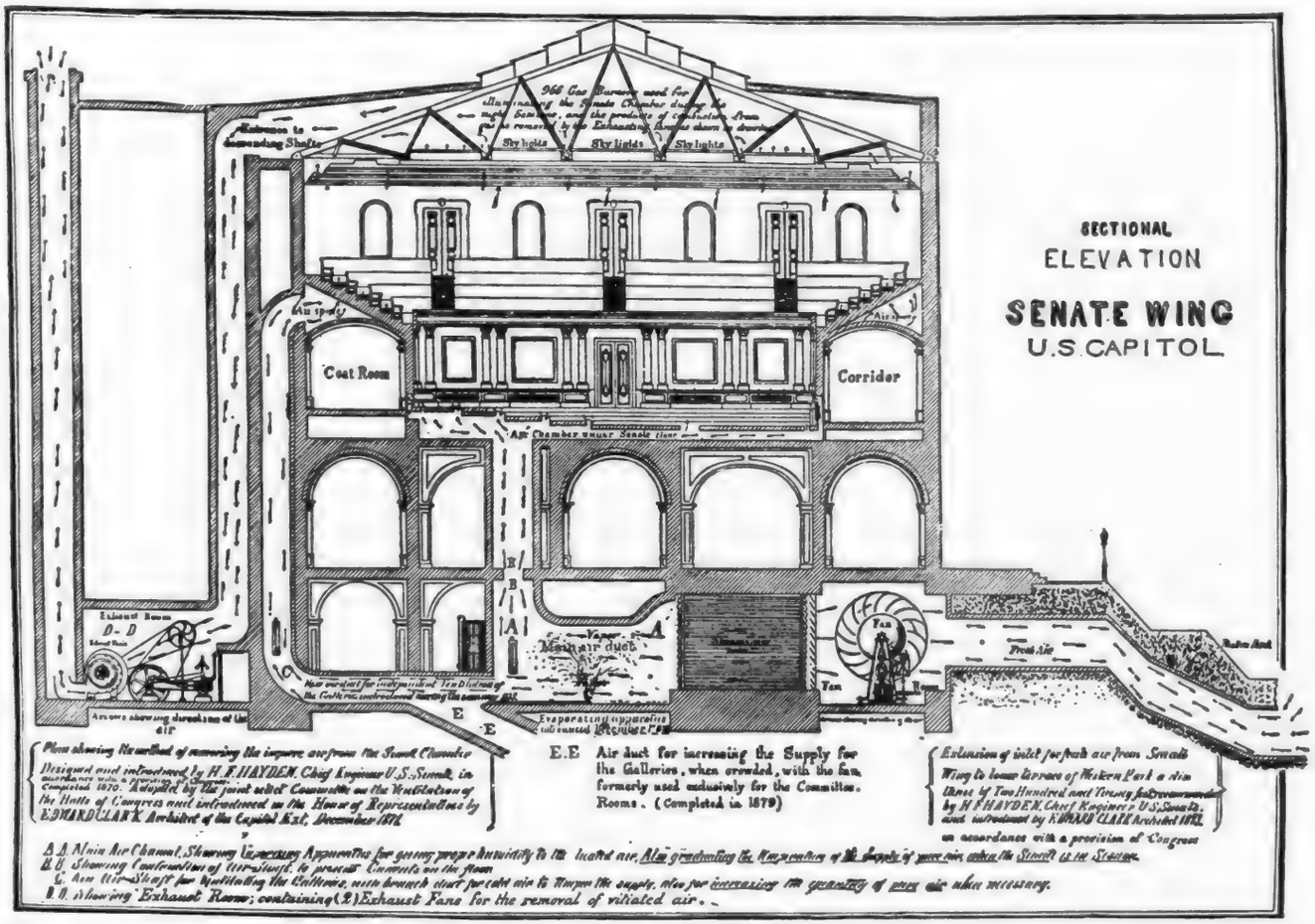
A A, main air channel, showing vaporizing apparatus for giving proper humidity to the heated air. Also graduating the temperature of the supply of pure air when the Senate is in session.

BB, showing construction of air shaft to present conduits on the floor.

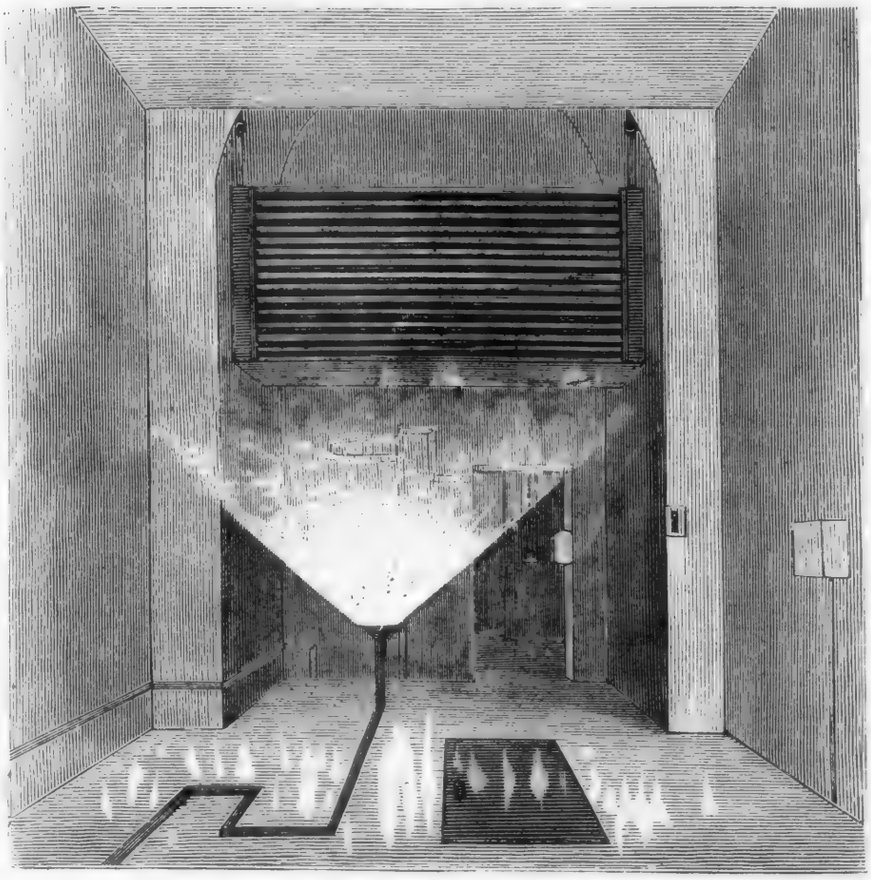
C, showing air shaft for ventilating the galleries, with branch duct for cold air to temper the supply, also for increasing the quantity of pure air when necessary.

D D, showing exhaust room, containing two exhaust fans for the removal of vitiated air.

E E, air duct for increasing the supply for the galleries, when crowded,


SECTIONAL
ELEVATION
SENATE WING
U.S.CAPITOL
Coat Room
Corridor
Skylights
Skylights
Skylights
Fan
Fan
Room
Vapor
Main air duct
Exhaust Room
D-D
Fresh Air
E
E
Plans showing the method of removing the impure air from the Senate Chamber
Designed and introduced by H. F. HAYDEN, Chief Engineer U.S. Senate, in accordance with a provision of Congress
Completed 1870. Adopted by the joint select Committee on the Ventilation of the Halls of Congress and introduced in the House of Representatives by
EDWARD CLARK, Architect of the Capitol Ext. December 1874
E.E Air duct for increasing the Supply for the Galleries, when crowded, with the fan formerly used exclusively for the Committee Rooms. (Completed in 1879)
Extension of inlet for fresh air from Senate Wing to lower terrace of Western Park a distance of Two Hundred and Twenty feet recommended by H. F. HAYDEN, Chief Engineer U.S. Senate, and introduced by EDWARD CLARK Architect 1874
in accordance with a provision of Congress
A A. Main Air Channel, showing Vaporizing Apparatus for giving proper humidity to the heated air. Also graduating the temperature of the supply of pure air when the Senate is in Session.
B B. Showing Construction of Air Shaft to present Conduits on the floor
C. Air Ventilating Shaft for ventilating the Galleries, with branch duct for cold air to temper the supply, also for increasing the quantity of pure air when necessary.
D D. Showing Exhaust Room; containing (2) Exhaust Fans for the removal of vitiated air.

Sectional Elevation of Senate Wing U. S. Capitol Showing Early Scheme of Heating and Ventilation



Apparatus for Purifying Air in the Senate Chamber

with the fan formerly used exclusively for the committee rooms (completed in 1879).

The fact that the Senate Chamber was illuminated by 966 gas burners during the night session is noted in connection with the arrangement in the loft for removing the products of combustion by the exhaust fans, as shown.

The notation in the lower right-hand corner reads:

"Extension of inlet for fresh air from Senate Wing to lower terrace of Western Park, a distance of 220 ft., recommended by H. F. Hayden, chief engineer, U. S. Senate, and introduced by Edward Clark, architect, 1873, in accordance with a provision of Congress.

Standard Screw Threads Adopted.

The American Engineering Standards Committee has just approved as American Standard a 32-page document, constituting the finished work of the Sectional Committee on Standardization and Unification of Screw Threads, in the field of threads for bolts, machine screws, nuts, and commercially-tapped holes. The committee, which has done this work under the joint sponsorship of the American Society of Mechanical Engineers and the Society of Automotive Engineers, was organized in 1920.

The report has been prepared in collaboration and agreement with the National Screw Thread Commission, which includes several members of the sectional committee, (and in which the S.A.E. and A.S.M.E. are the two civilian participating organizations). The present report is based upon the "Progress Report" of the commission.

By the adoption of the report of this committee, screw threads are narrowed down to, and standardized upon, two series—an "American Coarse Series" for general work, and an "American Fine Series" for work in which a finer thread is desirable, as with the special alloy steels used extensively in the manufacture of automobiles. The same form of thread is used in both.

The adoption of standard screw threads is perhaps the most important single advance in American industrial standardization, certainly in the mechanical industries.

The Coarse-Thread Series is the present "U. S. Standard" (or "Sellers") supplemented by the "A.S.M.E. Standard" below ¼-in., and the Fine-Thread Series is the "S.A.E. Standard" supplemented by the "A.S.M.E. Fine-Thread."

Different classes of fit ("loose," "free," "medium" and "close") are established, with corresponding numerical tolerances to provide for unavoidable inaccuracies of workmanship under practical conditions. A standard screw thread nomenclature and also a system of identification symbols for use in correspondence, drawings, and shop practice, are established.

Referring to international standardization, the foreword to the report states: " . . . the Sectional Committee hopes that further steps may be taken by mutual concessions which will result in bringing together the Whitworth (British) and the American systems of threads so as to secure interchangeability in the English-speaking world. The committee also looks forward to the time when, by conferences with the standardization associations of the countries using the metric system, agreements along similar lines for fits and tolerances for metric threads will be brought about."

Standardization of Pipe Flanges and Fittings

Rapid and important progress is reported by the sectional Committee on Pipe Flanges and Fittings, which is working under the procedure of the American Engineering Standards Committee and under the joint sponsorship of the American Society of Mechanical Engineers, Manufacturers Standardization Society of the Valve and Fittings Industry, and Heating and Piping Contractors' National Association.

The 1924 A. S. M. E. Standard for Cast-Iron Flanged Pipe and Fittings, for 125 lbs. steam pressure, is now in revised proof form, and undergoing vote of the sectional committee. While the present edition involves a number of changes, it does not differ in its broad outlines from the earlier form. One of the more important changes is the elimination of approximately 50% of the sizes above 10 in. in diameter; the older size series provided an unnecessary close spacing of diameters.

A rather remarkable piece of work has been done in the preparation of standards for steel flanges and flanged fittings, for 250, 400, 600 and 900 lbs. steam pressure, with 750°. superheat. The work of the sectional committee on this is nearly completed, although the work was begun less than a year ago, and involved the laying down of complete new designs, actually in advance of practice, some of the higher steam pressures having never been commercially employed,—a case of necessary standardization in advance of the development of practical applications.

Extensive work on pipe and pipe fittings accomplished during the last four or five years in Germany, Switzerland and Holland, by the national standardization bodies working in close co-operation, has now reached a tentative conclusion. Germany, Switzerland and Holland have under consideration well-advanced drafts of standards for pipe flanges and fittings that are in very close agreement. It is quite likely that western and central Europe will adopt a comprehensive international system of pipe and pipe flange standards, in the not far distant future, and this system will include all kinds of metallic pipe,—cast-iron, steel, etc.,—and the fittings used with all types of such pipe, together with standard sizes and forms of gaskets and other accessory items.

Legal Decisions

Water Heating Rates

The Idaho Public Utilities Commission, establishing rate schedules for the Idaho Power Company, considers that it would be inequitable to require customer's whose premises have been equipped for water heating under a low, flat rate to be changed abruptly to higher meter rates, even although it appeared that the cost of generating and distributing power for the existing service was greater than the rates in force, and that the system of flat rates is productive of waste of power, and a slightly lower rate was fixed for those who had had their premises equipped for this class of service than for future customers.

Increased Steam Heating Rates Upheld

Suit was brought by the assignees of several steam heat consumers against the Kansas City Light & Power Company to recover the amount of alleged excess charges paid by such consumers for steam heat furnished during the period from August 1, 1917, to March 1, 1918. From a judgment for the plaintiffs the company appealed to the Supreme Court of Missouri.

Prior to the first mentioned date the utility was charging and collecting, for heat furnished, compensation based upon rates contained in its schedule on file with the Public Service Commission, and in force as such. It filed a new schedule, which went into effect on that date. Subsequently, on petition of consumers, the commission found these rates unreasonably high, and fixed a lower schedule, which took effect March 1, 1918. The company sought no review of this schedule.

The plaintiffs' case was based on the claim that the rates for the period in question were excessively high and unjust, and therefore unlawful. Later rulings of the commission, however, made September 27, 1919, displaced the schedule put into effect March 1, 1918, which was found to be "inadequate, unjust and unreasonably low," and increased the rates for steam heating. It was therefore held, Marty v. Kansas City Light & Power Co., 259 S. W. 793, that these later rulings showed that the rates which the plaintiffs claimed were reasonable, and all that they lawfully could have been required to pay, were confiscatory, and showed that the rates which they actually did pay were so low as to be confiscatory of the utility's property, and the oral and independent testimony, not contradicted, nor seriously controverted, showed the same thing.

The Supreme Court concluded: "The rate paid by the consumers from August 1, 1917, to March 1, 1918, was lawful, having been filed, and going into effect, under the provisions of sections 10497 and 10516, R. S. (Mo.) 1919, and was further lawful, in that it was neither unreasonable nor excessive as against the consumers, but was in fact unrenumerative to the defend ant company. Requiring the consumers, as continuing to take that service, to pay the rate in accordance with the applicable rule for monthly payments made by the Commission, was not coercion of the consumers under the circumstances, nor an exaction from them of anything which they are entitled to recover, and the judgment in favor of plaintiffs should be reversed."

Countermanding Orders for Equipment

Despite misconception quite general, no practical means have yet been devised for holding a customer to an order signed by him so long as, through failure of the addressee to have yet accepted it, the customer has no hold on the latter. The general principle that unless an agreement binds both parties to it neither is bound has not only been frequently applied by the courts to the sale of goods in general, but has been specifically applied in the heating equipment field. An exception to the general rule arises often in the sale of real estate, but seldom in the sale of commodities. That exception is that, for a valuable consideration, one may buy an option to buy or sell.

It is fundamental law that an offer to buy goods—and that is all that an order legally amounts to—is subject to withdrawal before its acceptance. And the courts have frequently declared that an order is subject to countermand before its acceptance, although it may contain an express provision that it is not subject to countermand. Insertion of that provision may be justified as a business policy, because of its tendency to discourage countermanding, but it is not to be relied upon as precluding the signer from cancelling his order before it has been converted into a mutual contract by the addressee's acceptance.

In a Wisconsin case (99 Northwestern Reporter, 332) a boiler manufacturing company sued for damage for breach of a supposed contract for the purchase of heating equipment. An order for a boiler and an order for radiators were signed by defendant, being taken by a traveling salesman, but they expressly recited that they were subject to approval by the company. The same day that the orders were taken and mailed the defendant mailed a letter asking that they be cancelled. The Wisconsin Supreme Court decided that whether there was a valid countermand depended upon whether defendant's letter was received before plaintiff mailed a card signifying acceptance of the orders. And, it being found that the letter was received first, judgment was ordered in defendant's favor. The court added:

"The orders given by the defendant to the plaintiff's agent were by their terms only to become binding if approved and accepted by the plaintiff company. Up to the time of such approval and acceptance they could be withdrawn or canceled by the defendant. The whole transaction being by mail, the acceptance took place and the contract became binding at the moment when the postal card of acceptance, properly addressed, was deposited in the post-office by the plaintiff, unless the offer had been previously withdrawn."

When Buyer Repudiates His Contract

A Pennsylvania court had occasion to hand down a decision which still correctly reflects the law on important phases relating to the rights of a manufacturer of heating equipment, or of a heating contractor, where one who has agreed to have equipment installed announces that he will not go ahead with his contract.

In this case—E. Keeler Company vs. Schott, 1 Superior Court Reports, 458—it appeared that plaintiffs had a verbal agreement to install in defendant's hotel a heating apparatus, consisting of a steel boiler, steam pipes and fittings and radiators. They alleged that they entered upon the work and proceeded to specially manufacture a boiler and had it nearly completed when defendant declared the "job off." They sued for the profits they would have made if they had been permitted to carry out the contract, and the cost of labor and materials expended in constructing the boiler.

First, it was denied by defendant that any agreement was entered into; he claiming that there were mere verbal negotiations looking toward a formal contract. However, the jury found that there was an actual verbal agreement.

The opinion of the Superior Court was taken up mainly by a consideration of the question as to the measure of damages recoverable in cases of this kind. The court followed the general rule that the measure varies according to whether the subject of sale has market value or not. On one hand, plaintiff attempted to show that the particular boiler was specially manufactured and therefore could not be disposed of elsewhere to advantage.

Referring to the fact that the trial judge had instructed the jury that if there was a contract, and if the plaintiffs prepared the boiler for this particular place and for this job, then they would be entitled to recover the value of it in addition to the profits they would have made on the whole contract, the Superior Court said:

"By value we suppose the court meant the cost of the labor and materials, for there was no other evidence of its value. The result was to give the plaintiffs the cost of the labor and

materials which went into the boiler notwithstanding the fact that it is an article of merchandise which may be bought and sold in the market, and may be worth in the market all that was expended upon it. . . . If the title had not passed, the plaintiffs were entitled to recover only such damages as they sustained by the breach of the contract, and, as they still own the boiler, they have received compensation to the extent of its value. If, supposing that the title had not passed, the fair market value of the boiler in the condition it then was was equal to the cost of the labor and materials, the plaintiffs would be compensated by the profits they would have made on the entire contract, and that would be the measure of damages. But if its value, in the condition that it was, was less than the cost of the labor and materials, it would seem that they would justly be entitled to recover the difference in addition to the profits. It is necessary, then, to decide whether the title to the boiler had passed to the defendant. Whether the contract be regarded as a contract for work and labor merely, or as a contract for the sale and purchase of a thing to be manufactured, or as partaking of the nature of both it was executory [unperformed]. . . .

"In the case of an executory contract of sale of goods not specific, the rule undoubtedly is that the measure of damages for refusal to receive the goods is the difference between the price agreed upon and the market value on the day appointed for delivery. . . . Where an agreement is for the sale of goods to be manufactured the same rule applies as in the case of unspecified chattels. The contract is executory and the title does not pass until the manufacturer is completed and made ready for delivery."

Because there was no showing that it was intended between the parties that title to the heating plant should pass to the defendant buyer before actual delivery, it was concluded by the court that "in the meantime the boiler was as completely owned by the plaintiffs as were the materials of which it was constructed. They might have sold it, or appropriated it to any other use without subjecting themselves to liability to the defendant. If it had been destroyed the loss would have been theirs, and it might have been seized on execution for their debts."

Specifications for Steel and Wrought Iron Pipe Approved by A. E. S. C.

The American Engineering Standards Committee announces the approval, as Tentative American Standards, of A. S. T. M. Specifications for Welded and Seamless Steel Pipe and Welded Wrought-Iron Pipe.

The A. S. T. M. initiated work on specifications for steel pipe, in 1915, and on wrought-iron pipe, in 1918.

In 1921 the work broadened to include seamless as well as welded pipe, and modified to bring them in accordance with the American Standard Pipe Thread.

The action by the A. E. S. C. on approval was taken in accordance with the recommendation of a special committee under the chairmanship of Stanley G. Flagg, Jr., and containing representatives of numerous organizations, including:

American Society of Mechanical Engineers, American Society of Refrigerating Engineers, Manufacturers Standardization Society of the Valve and Fittings Industry, National Tube Company, and Heating and Piping Contractors' National Association.

Control of Humidity in Storerooms

If eggs are stored in an atmosphere that is too damp, they will absorb a part of the material of the strawboard fillers in which they are packed and take on an undesirable odor and taste. On the other hand, if they are stored in an atmosphere that is too dry, they will shrink excessively and become stale. The humidity of the air in the storeroom determines the quality of cold-storage eggs.

Of course, where an undesirable condition of humidity arises because of the circulation of outside air that is too damp or too dry, a properly-designed ventilating installation, with an air washer or drier, is an easy solution.

G. D. Allman, general manager of the United States Cold Storage Company, writing in *System*, of Chicago, tells of a means adopted by his company where the requirements called for a cheap and flexible method of reducing temporary excessive humidity. The method uses the well-known calcium chloride principle for absorbing the moisture from the air. To obtain the maximum drying effect, the company is using calcium chloride in specially-constructed containers, as shown in the accompanying illustration.

The container consists of a tight, rectangular, galvanized-iron box 18 in. wide, 22 in. deep and 10 ft. long, open at both ends and with a tight, hinged lid in three sections. It is reinforced with iron straps and mounted on a wooden base so that one end of the box is 6 in. higher than the other end.

An open, wooden platform supported an inch above the bottom of the box is placed inside. A bucket is placed at the lower end of this box or trough so that moisture collected by the calcium chloride will drain into it. At this lower end, and flush with the bottom edge of the box, a horizontal wooden stool supports a 16-in. electric fan, which blows a horizontal current of air against the chunks of calcium chloride with which the box is filled. This container will hold about 100 lbs. of calcium chloride, broken into chunks somewhat smaller than a man's head.

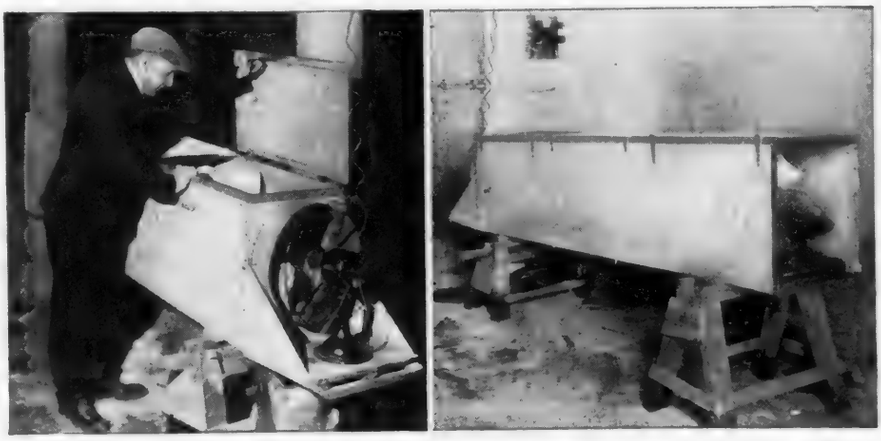
The hinged lid makes even filling easy. The calcium chloride is simply broken into chunks and shoveled in a uniform layer into the box. The large-sized chunks have been found much more effective than smaller pieces. Smaller pieces, it was found, become cemented together as the salt takes up water, and therefore prevent the free circulation of air.

The box is supported at an angle, with the fan end about 6 in. lower, and the fan is so placed that it will blow a horizontal draft of air into the box, so that the air will circulate about the chunks of calcium chloride instead of only passing over the top of them.

The platform in the box keeps an unobstructed passage open for the salt solution, which runs into the bucket at the end, and so helps to prevent cementing of the chunks.

The principal advantage of these air driers is their flexibility. One drier to each 1,000 cu. ft., operated about three days, will bring the humidity down about 10 points. Working on this basis, as many of them are placed in a room as are necessary to bring the humidity down to a desired point in a given time.

Of course, it is the calcium chloride that does the work. The containers simply make conditions better for rapid drying.



Views of Calcium Chloride Container, Equipped with Fan, For Absorbing Excessive Humidity in Cold-Storage Room

Correspondence

Selection of Pumps for Vacuum Heating

EDITOR HEATING AND VENTILATING MAGAZINE.

On page 87 of the July issue, R. C. Miller, in discussing the value of vacuum heating as a means of temperature control by varying the vacuum in the radiator, questions the method of selecting pumps and the usual method of operating a vacuum system where the vacuum does not extend into the radiator.

The use of a vacuum pump on the return lines of a building heating system was originally adopted for either or both of two reasons, (a) to improve the circulation of steam in and the removal of condensation from the system, and (b) to reduce the back pressure on the generating units in cases where exhaust steam was used for heating. It has only recently been demonstrated that a heating system when operated under a vacuum from the low-pressure side of the reducing valve to the pump is productive of a considerable degree of economy. It is also recognized that under other conditions, operation with a vacuum might conceivably produce entirely opposite results.

There are still many heating engineers who have not been fully convinced that a vacuum can be maintained in the mains and radiators of the system. (see Journal of A. S. H. V. E., March, 1924, pp. 259 to 261) and also of the economy possible. For this reason they do not advise their clients of these advantages, but merely recommend them as a means of positive circulation.

In determining the size of a vacuum pump usually the only information available, as an index to the load on the pump, is the radiation to be installed in the building. It is considered good practice to allow ¼ lb. of condensate per hour per square foot of equivalent direct radiation. It is also good practice to assume a factor of 1/3 lb. per square foot per hour in order to allow for condensation in the supply mains. For a system of 26,000 sq. ft. of radiation at 1/3 lb. of condensate per square foot we would have 8666 lbs. of water per hour or 17.4 gal., per minute as the condensate that would have to be handled under maximum normal conditions. Certain pumps rated for 26,000 sq. ft. have a rated capacity of 35 gal., per minute. In other words, the water capacity of these pumps in all cases is double the normal amount of condensate in order to take care of peak load and slugs of water coming back from the system.

Reciprocating steam pump practice has developed a satisfactory rating for the displacement of air required per square foot of equivalent direct radiation. Since certain pumps have combined air and water impellers, an actual displacement equal to the best reciprocating steam-driven units, a calculation based on piston pump practice should prove satisfactory in operation. This has proven to be the case and air capacity ratings have been determined by deducting the water volume and the slip from a figure of one cubic foot displacement for each thousand square feet of radiation. In practice this displacement calculation reduces to a factor of eight times the volume of condensate. In other words, 26,000 sq. ft. of radiation against 8666 lbs. of water per hour, or 144 lbs. per minute, equals 2.3 cu. ft. of condensate. Multiplying this by 8 gives an air capacity figure of 18.4. These figures have proven to be conservative, for experience has shown that except on very tight jobs they cannot be materially reduced to get satisfactory and economical results.

J. EARL SEITER.

Detroit, Mich.

Why Not Extend the Vacuum to the Inside of the Radiator?

EDITOR HEATING AND VENTILATING MAGAZINE:

In any discussion relating to vacuum heating we quite often wander in circles around one another. Possibly I may be open to the same criticism, but, at any rate, it seems to me we are missing the point. Let's get down to fundamentals and look at this matter practically—the boiler controls the vacuum, not the pump.

The usual conception is that the pump controls the degree of vacuum in the system, but right here we are wrong. As a matter of fact the pump is used mainly when starting up and is run for a time in order to bring the vacuum up to a predetermined point, after which the pump is stopped. Whenever the vacuum falls below this the pump automatically cuts in and operates long enough for the vacuum to again reach this point (usually 10 in.).

Some electrically-operated pumps can operate up to 14 in. of vacuum, after which they will churn the same as would happen if the suction to the pump were closed. It is impossible for such a pump to pull a greater vacuum, yet, at the same time, a gauge on the radiators might read 25 in. of vacuum. Then where does this excess of vacuum come from? The pump has nothing to do with it. It is simply a matter of operating the boiler on the same principle as a vapor heating system, that is, the supplying of steam at a slower rate than it is condensed in the radiating surfaces. If this method is followed, steam will not be passed through the traps, because the pull, if anywhere, is backward to the lowest point of pressure, which is in the radiators.

Of course, if we have a notion that the only indication of economy is a high vacuum at the pump, we will continue to run the pump longer than it is needed and if the vacuum is still not high enough to suit us, jet water will be turned on, with resulting waste, as the steam is pulled through the system faster than it is required in the heating surfaces. This is no fault of the heating system. The trouble lies with us through improper operation.

THREE PURPOSES OF A VACUUM PUMP

If we want thoroughly and clearly to understand this discussion and so reach an early conclusion of the problem, it is well for us to define, first, the purposes of a vacuum pump. So far as I can see, these purposes are three in number. Vacuum pumps are necessary if we want to produce a quick and positive circulation when starting up. The large amount of air in the system must be eliminated before the desired heating effect can be obtained. On a small or medium size job we may find that a vapor system will be all that is required, but on an extremely large job a vacuum pump is desirable. But it is only needed when starting up and so the split system has come into use, that is, a vacuum pump for starting up the system and getting it under way quickly, after which the pump is stopped, then vapor heating specialties for operation under normal conditions. We should not run the pump any longer than necessary to do this as it costs something to run an automatically-operated electric vacuum pump, usually anywhere from $200 to $500 per season on a job of, say, 16,000 sq. ft. of radiation.

Then we find vacuum pumps useful wherever the height above the water-line of the boiler is insufficient to insure the gravity return of condensate. Lastly, the vacuum pump is a favorite of the one who installs a job in such a way that pockets are left in radiator runouts and many other places. As a general rule, a vacuum pump will cover up such mistakes and insure the necessary lift, in fact, in the early stages of vacuum heating the use of this method of heating was promoted largely through statements that the vacuum system would remedy all such defects. Later it was found that poor workmenship followed as a matter of course. Consequently we hear less of this claim today. However, the vacuum pump is still an asset whenever lifts are unavoidable, due to established grades or elevations.

BENEFITS OF VACUUM WITHIN RADIATOR ALWAYS UNDERSTOOD

Beyond a doubt the manufacturers have always understood the benefits which could be derived through operation of a system theoretically by means of a vacuum extended to the inside of a radiator, but, at the same time, they have been up against the impregnable stone wall of practical difficulties that have always stood in the way of obtain-

ing this ideal. Lastly, the desired benefits have been obtained in other ways, either by means of vapor-vacuum heating or else by means of intermittent heating.

Certainly it would take a lot of college professors to control the vacuum by proper regulation at the boiler or by adjustment of the pressure-reducing valve in conformance with outside temperatures. Also, the proper degree of tightness in the system is hard to obtain, especially with the general lowering of standards of today as regards quality of workmanship. Under these conditions it is difficult to maintain a high vacuum even with packless valves. Union connections on radiator valves are responsible for much of the air leakage and leaks will also occur at many other points in the system.

There is no particular reason for the manufacturer of vacuum heating specialties to fight the pump manufacturers' battles, as the former also sells vapor heating specialties. But if we still have doubts as to whether the manufacturer is fully awake to the possibilities in his field we have only to recall the many old devices once used in a vain endeavor to obtain the full benefits of a vacuum. Some of these devices were full of mercury, but the mercury had a way of getting out of the device and where it went it ate up the pipe, or the air in the system contained oil from the exhaust steam which mulsified with the mercury. Another device contained water which likewise refused to remain in the proper place and as this necessitated frequent refilling of the device it was not long before the water-line of the boiler was raised.

What would happen to these hermetically-sealed thermostatic traps under a very high vacuum? With low temperatures the volatile liquid within these traps tends to contract and deflate the trap, but under lowered outside pressures would not the force of the pressure within the trap be greater than the temperature force tending to contract the trap? If so, the trap must swell up to the point of destruction, or at least the life of the trap must be measurably decreased.

About this time someone will ask, how is it possible practically to vary the temperature of the radiating surfaces for the complete range of outside temperatures, yet have pipes large enough to pass the greater volume of steam at low pressures, not forgetting to point out at the same time that the pressure drop (friction) varies as the square root of the velocity. So the following table is offered which, so far as theory goes, proves conclusively that the suspicions of the questioner are justified. For example, at 40° outside temperature, the total volume (therefore velocity) of the steam to be passed through the system must be about three times as great as with an outside temperature of 0°.

The answer to this is that only about half of the steam by weight is required for the same heating effect. Furthermore, in choosing our pipe sizes we are limited to commercial sizes and so must select the nearest pipe size, which is usually somewhat greater than would otherwise be used. Also, the greater pressure differential which exists at the higher vacuum should be sufficient to take care of the increased pressure-drop at higher velocities. Finally, we need not care about the increased velocities for, after all, we can heat the building intermittently* by means of higher pressures, therefore with less volume and velocity of steam, yet obtain the same heat delivery over any given period of time.

A word might be said in explanation of the table. The total heat losses in per cent were obtained from a curve in Webster's "Steam Heating," as such losses have been found to be not quite in direct proportion to the change in outside temperature. The transmission from radiating surfaces, of course, must equal the heat losses, so if we assume, as in the table, 1000 sq. ft. of 2-col. 38-in. cast-iron direct radiation for an outside temperature of zero, we readily obtain the transmission per square foot. With these data in hand we obtain certain conversion factors which, referred to those in the Guide, A.S.H.&V.E. (for the heat effect of different radiators under varying steam temperatures), give us the corresponding pressures, temperatures and other properties of steam as given in the table.

As to the matter of the proper size of vacuum pump, it seems to the writer that the maximum amount of air to be handled is when the system is started up, at which time it is completely full of air. If the pump is large enough to handle this peak load, it surely will take care of leakage at other times. Furthermore, as the system becomes heated the leakage is less because the joints, being hot, expand. As for re-evaporation of steam, there should be none, that is, providing the vacuum is extended to the inside of the radiator by limiting the steam supply to the requirements (either at the boiler or pressure-reducing valve) and by adjusting the thermostatic valves so as to remain open at temperatures below 210°.

The evolution of a heating system from one-pipe through successive stages of two-pipe and air-line to vacuum and vapor systems was mainly because of the more effective removal of air thus obtained. So the vacuum system came about, not, as at first commonly thought, because of the possible range of lower temperatures, but rather because of the quick and positive means of establishing circulation. However, the proof of the pudding is in the eating, so if one has a gauge on a radiator indicating a vacuum, it is hard to convince him that this vacuum and consequent saving of steam come about only through reduction of steam supply at the source and not because of the vacuum pump.

All this is possible, but the constant attention and degree of regulation to a nicety—will it be done and why do it this way if we can do it easier some other way? In conclusion and as an example of this point, it is well to bear in mind that there are many cases where the large distance above the

* This does not mean the alternate turning off and on of steam, but rather fluctuations in the pressure from low to high vacuum and vice versa, making, of course, the time variations from one to the other according to the outside temperature.

TABLE SHOWING INCREASED VOLUME IF VACUUM IN RADIATOR WERE VARIED WITH OUTDOOR TEMPERATURE.

Outside Temperature Deg. F.	Heat Losses Per Cent	Total Heat Losses and Transmission	Transmission per Sq. Ft. Rad. Surface	Conversion Factor	Abs. Steam Pressure Required Lbs.	Corresponding Temp. for this Transmission	Inches of Vacuum	Specific Volume of Steam	Total Wt. of Steam Lbs.	Total Volume of Steam Cu. Ft.	Latent Heat of Steam B. T. U.	Increase in Volume Per Cent
0	100	266000	266	.909	19.7	227	0.0	20.4	276	5626	961	0
10	82½	219450	220	1.101	12.6	204	4.3	31.0	223	6907	975	23
20	66	175560	176	1.376	7.4	179	14.9	51.1	177	9060	990	61
30	50½	134330	134	1.793	4.3	156	21.1	84.7	134	11333	1004	103
40	36	95760	96	2.523	2.1	128	25.7	168.0	94	15758	1020	180
50	23	61180	61	3.950								

water-line enables the return of water without the use of vacuum pumps, and in nearly all such cases the operators do not take the trouble to run the pumps.

New York City. R. W. T.

The Almert Central Home Service

A solution proposed by Harold Almert, a well-known heating engineer, of 209 South LaSalle St., Chicago, Ill., who has long specialized in district heating work, provides for a central home service plant, following the lines of the block heating plants which have been proposed at various times.

In accordance with this plan, selection is made of an entire block of choice vacant property, surrounded by well built-up, high-grade buildings, and suitably located with reference to transportation, etc. A dozen to twenty individual residences, depending on the size of the block, are built on this site. Then in the center or at the end of the block there is built an inconspicuous, submerged central home service plant of harmonious design, terraced over so that only the caretaker's vine-clad cottage or second story of the plant is visible above ground. Because of mechanical draft to be used, the only chimney required will be one of old English design built so as to form a part of the caretaker's cottage exterior.

This central service plant will be operated to render the following collective services to all houses in the block:

Steam heat, metered and available at all hours, kept at a constant automatically-regulated pressure, plus humidity control.

Metered hot water supply in unlimited quantities day or night at any temperature and thermostatically controlled. The plan contemplates the heating of this water by steam.

Refrigeration of ice boxes. From the underground mains two insulated ½-in. pipes enter the ice box connected to a coil in the ice chamber. The cooling medium is circulated through this coil continually from the central plant. In the center of the cooling coil is a metal box containing three drawers or trays for making ice cubes. By installing a small flat coil or block tin in the refrigerating coil compartment and connecting same to the cold water supply through a filter and a faucet on the outside of the icebox, it will be possible to obtain automatically filtered ice water at all times.

Individual family laundry service is included in the form of a complete institutional-sized steam laundry equipment, in which the rotary washers are steam heated and where dryers and mangles are steam heated.

Garbage and refuse removal and incineration, joint garage facilities and window washing service are other features of the plan.

Independent fee ownership in the individual homes is provided for, with an undivided joint interest in the service plant. The recommended operation basis is "cost, plus 10%."

Huge School Building Programs for American Cities

Further details of the extensive school building programs laid out for some of the larger cities of the country, compiled by the *American School Board Journal*, make an impressive showing.

In Charleston, W. Va., for instance, the building program involves $1,350,000 and covers a period of five years. For the calendar year $215,000 will be expended. In Charlotte, N. C., a building program to be carried out immediately involves an expenditure of $1,000,000.

Cleveland, Ohio, has a new building program, aggregating $18,000,000, in addition to the building program adopted in 1920, which involved a cost of about $24,000,000. The tentative future building program covers the period 1925-1928 inclusive. The actual expenditure for new buildings in 1924 will amount to $3,505,000.

In Columbus, Ohio, the extensive building program for the five-year period now ending just about satisfies existing needs and if the increased enrollment each year is to be properly cared for, new school buildings must be provided each year in the future. The Columbus Board of Education is now planning the erection of two junior high schools and one elementary building.

Des Moines, Ia., is in the process of completing a $7,000,000 building program started in 1921 and to be finished by 1926.

Guthrie, Okla., adopted a building program last December involving an expenditure of $280,000. It calls for a new high school and additions to other buildings, all to be completed next year.

In Houston, Texas, a building committee is making a complete survey of the school building needs in that city and is to recommend a building program which will take into consideration the present needs and those of the next five years. In June last a bond issue of $3,000,000 was voted, the proceeds of which will be available for the beginning of the building program. It is estimated that at present there are 8.000 seats short. William Ward Watkin has been appointed consulting architect to advise with the superintendent and building committee in the construction work.

In Indianapolis, Ind., a comprehensive four-year building program has been adopted, involving a total expenditure of $9,912,583. The contracts to be completed this year will require $2,136,038. The balance, $7,776,500, will be expended during the years 1925-1927.

Newark, N. J., in April, 1923, adopted a two-year building program involving a cost of some $1,800,000. In addition, improvements and additions to various schools are contemplated, involving an expenditure of $80,000.

Long Beach, Cal., last January voted a bond issue of $4,900,000 to meet the school needs for the next three years. Of this amount $1,150,000 will go for a new high school.

Milwaukee, Wis., has agreed upon a five-year building and future sites program, involving an expenditure of $8,438,000. Sites are estimated to cost $813,000 and buildings, $7,625,000. The annual outlay for new buildings is estimated at $1,500,000.

Minneapolis, Minn., has made an allotment of bonds for the five-year period 1924-1928 to the various city departments. Under this program the schools will receive $9,500,000 for new buildings and sites.

In New York the Board of Education is carrying out the greatest school building program which any city in the Western Hemisphere has ever undertaken. Since the present city administration came into office, on January 1, 1918, approximately $160,000,000 have been authorized for the purchase of school sites and the erection of school buildings. There are now under construction 74 buildings, and plans are being drawn for 121 additional schools, making a grand total of 301 new schools and additions. The actual expenditures in the year 1924 will be about $60,000,000.

In Portland, Ore., a $3,000,000 bond issue was authorized in June of this year, following a survey made last year by the United States Board of Education. The result was a building program extending over 15 years, 1922-1937, divided into three 5-year periods. The program contains the recommendation in regard to each building for each five-year period. For the first five-year period the sum called for by the building program is $15,000,000, and, so far, the Portland Board of Education has recommended a bond issue of $5,000,000 for this period.

Fort Worth, Texas, has a building program in course of preparation which will probably cover a period of ten years. The local board is making a school building survey and expects to call for a bond issue of $2,000,000 in the Fall.

Knoxville, Tenn., has adopted a school building program as the result of a school survey conducted by William B. Ittner, of St. Louis. The survey is intended to take care of the city's needs up to 1940. A bond issue, it is expected, will be voted this Fall for $1,500,000, to cover immediate necessities.

New Bedford, Mass., has plans under way to build three junior high schools, with a capacity of 2,000 pupils each, at a total cost of about $3,000,000. Next year it is planned to build a 20-room school to cost $500,000.

Deaths

Alexander S. Cameron, for many years president of Cameron-Schroth Co., Chicago, Ill., dealers in heating supplies, died at his home in that city August 31. He was 54 years old. He leaves a wife, one son, William Alexander Cameron, and two daughters.

Reappointment of Present Members of Standardization Committee

Announcement is made by the Heating and Piping Contractors' National Association that the services of the present members of the Committee on Standardization have been retained for the coming year. The committee consists of Walter L. Fleisher, New York, chairman; Ralph S. Franklin, Boston; Harry M. Hart, Chicago; Robert C. Morgan, Philadelphia; S. Austin Pope, Chicago; and R. A. Wolff, New York.

During the past two years this committee has brought out the results of its study of figuring radiation in a manual entitled, "Heating and Piping Contractors' National Association Engineering Standards."

A further step was taken to simplify the method of figuring radiation by the formula adopted so that it would be easily adapted to the use of the estimating room through the publication of "Standard Radiation Estimating Tables" for the cities of Birmingham, Boston, Buffalo, Chicago, Cleveland, Denver, Detroit, Kansas City, Los Angeles, Madison (Wis.), Memphis, Milwaukee, New York, Philadelphia, Pittsburgh, San Francisco, Salt Lake City, St. Louis, St. Paul and Washington.

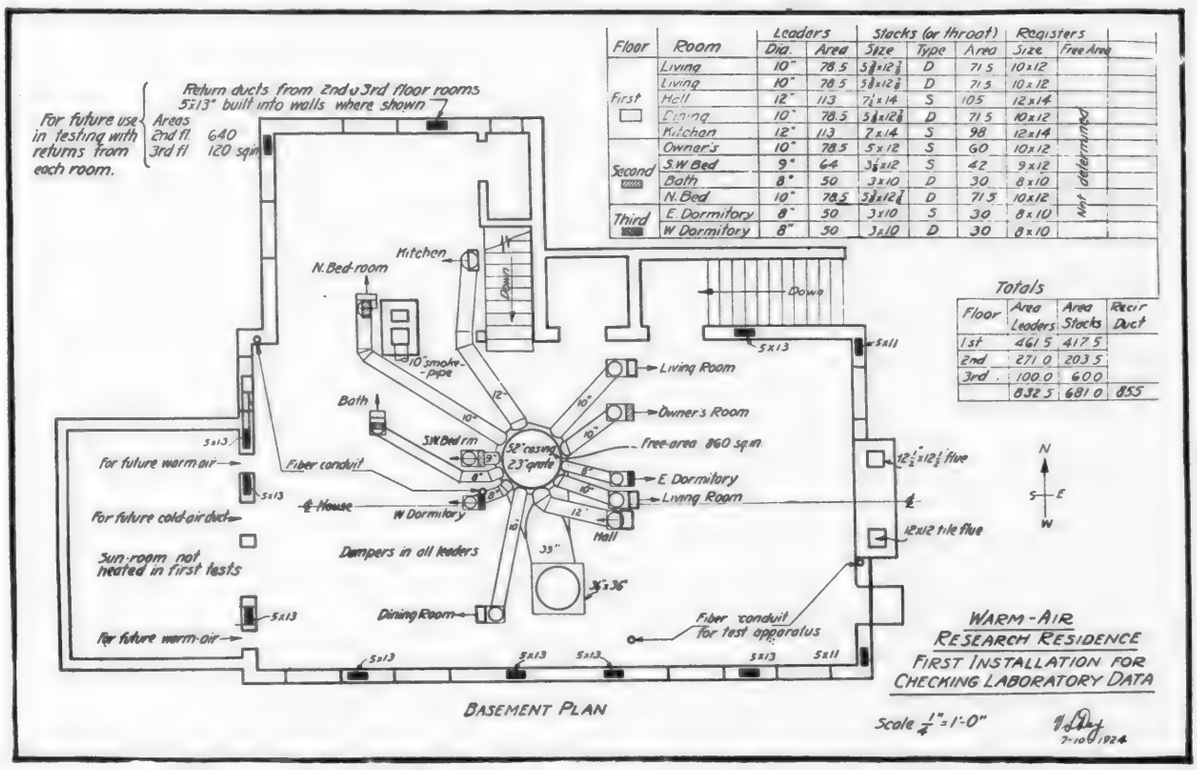
As the committee stated in its last report, the six topics of study scheduled for the coming year are:

1. The extension of standard roughing-in dimensions for radiator valves.
2. A standard method of selecting boilers.
3. A further extension of exposure factors and base temperatures to other cities than those already developed.
4. A study of sheet metal work and sizes for indirect heating.
5. Proper sizes and heights of chimneys.
6. Pipe sizes for low pressure heating.

How the Warm Air Heating Research Residence Looked on September 4, 1924

Warm Air Heating Research Residence Completed

The finishing touches have been put on the Warm-Air Heating Research Residence which has been built by the National Warm-Air Heating and Ventilating Association, at Urbana, Ill. It will be formally dedicated and opened during the mid-year meeting of the association, in Urbana, December 2, 1924. As will be noted from the accompanying plan, the building has been equipped with a carefully-designed warm-air furnace heating plant which will be used both for independent tests and for checking the laboratory test data on warm-air furnace heating which have been collected during the past few years at the University of Illinois, under its agreement with the National Warm-Air Heating and Ventilating Association.



Arrangement of Furnace and Air Ducts in Warm-Air Heating Research Residence at Urbana, Ill.

(*Heating and Ventilating Magazine, October, 1924.*)

I. What Happens When Fuel Burns

By Samuel S. Wyer

Associate in Mineral Technology, U. S. Smithsonian Institution.
(By Science Service)

It is perfectly clear that a crying need exists for a better knowledge on the part of the American public of the principles of heating and ventilation. As has been well said, the best articles on this subject are published in journals which never reach the eyes of those most vitally affected. This department, which will be a regular feature of THE HEATING AND VENTILATING MAGAZINE, *is designed to serve as a channel for spreading the gospel of good heating and ventilating practice. Each month a short article will be presented here which will be in suitable form to be passed on, with advantage, to the general public.*

So, after you have read the magazine, cut out the article which follows and send it to your local newspaper. If you can do it in the name of your local organization, so much the better. As time goes on, we shall reproduce clippings from newspapers which have published these articles.

BURNING of every fuel is the chemical combination of the ingredients in the fuel with oxygen of the air. Different fuels require different quantities of air applied in different ways.

One pound of coal, occupying 21 cu. in., requires about 15 lbs. or 200 cu. ft. of air. The volume of air is about 16,000 times the volume of coal. One gallon of oil, 7½ lbs. or 231 cu. in. requires about 142 lbs. or 1,866 cu. ft. of air. The volume of air is about 14,000 times the volume of oil. One cubic foot of natural gas requires from 9 to 10 cu. ft. of air and one cubic foot of manufactured gas from 4 to 5 cu. ft. of air. Efficient fuel use can be secured only by the use of the correct amount of air and applied in the right way. This is entirely in the hands of the fuel user.

No general rule can be given for the exact adjustment of dampers, but proper adjustment must be ascertained by trial with each installation. In the typical house furnace or boiler, the dampers work as follows:

The draft damper, usually controlled by a chain from the living room, is generally a lift door in the ash-pit door and admits air underneath the fuel.

The feed-door damper consists of a slide in the feed door and admits air directly over the fire. If opened too wide it acts as a check.

The check damper, usually controlled by a chain to the living room, can admit cold air into the smoke pipe, reducing the chimney draft and retarding the burning of the fuel in the heater. This damper should be closed tight when fresh fuel is added to the fire.

The smoke-pipe damper will control the draft or drawing of the chimney and should always be placed between the furnace and the check damper and never between the check damper and the chimney flue.

The burning of fuel with perfect combustion will produce carbon dioxide, the same gas that is exhaled from the lungs, and water vapor. If the combustion is not perfect, carbon monoxide, a poisonous gas, and condensible vapors and smoke will be formed. No heating device has been or can be made that will absorb its combustion products, hence they must be properly removed from the house by adequate flues.

An opening should be provided at the base of all chimneys for occasional cleaning. Flues for solid fuels require larger connections than those for gas or oil. When bituminous coal is used, horizontal sections of flue pipes require frequent cleaning. With gas, the large amount of steam that must be formed when the gas is burned may give trouble in disintegrating the mortar lining of the ordinary chimney. This moisture is acid and will soon corrode ordinary thin black stove pipe, only galvanized connections should be used and flues should preferably be lined with a moisture-proof lining such as heavy steel galvanized pipe. Back or down drafts with solid fuels can be prevented by a hood at the chimney top; with gas, an opening at the bottom of the smoke pipe near the heater will protect.

Tests show that ashes frequently contain 50% of carbon. This is because the grates do not receive proper attention. In shaking grates, stop when the fire glow from above appears and before live coals go into the ash pit. Never leave ashes under the grates after shaking. Remove at once, as this will protect grates and give better circulation of air.

Even with proper combustion of fuel, however, the heating problem is only partially solved. The big task is getting the heat into the room, water or food that is to be heated in the most direct and effective manner. The ordinary furnace or water-heater for the average house does not have enough absorbing surface, with the result that the combustion products go into the chimney at too high a temperature and much heat is needlessly lost. This is especially marked when gas or oil are burned in the ordinary coal furnaces.

Water tanks, furnaces and pipes for warm air, water or steam, should be adequately insulated. Merely covering, as is frequently done, with one thin thickness of asbestos sheets is not enough. In fact, such a covering is worthless. The insulation must be about ½ in. thick to be effective and will then cause a marked saving in fuel.

Use of a thermostat, a device for controlling fuel burning so as to maintain a predetermined temperature in a room or water tank will always promote economy; saving from 15% to 30%. For room heating it contributes to the good health and comfort of the occupants.

(Next month: *"Putting the Heat Where Needed."*)

A. S. H. & V. E. Guide 1924-1925

With its contents greatly improved and enlarged, the A. S. H. & V. E. Guide 1924-1925 has been published by the American Society of Heating and Ventilating Engineers. The new edition, which is the third, contains 518 pages. The contents are divided into four sections which include technical design data, manufacturers' catalogue data, an index to modern equipment and society's roll of members.

The technical section has been amplified by the code for testing low-pressure heating boilers, and by data on pumps for heating and ventilating service, oil burning, and on pipe sizes for water service lines, while new data are given on infiltration of air, capacities of steam heating risers and on water heating. In the ventilating section new chapters are devoted to air washers, duct design, the Pitot tube, and additional data are given on the "comfort zone" and "effective temperatures." There is also a complete revision of the chapter on automatic ventilators. In every case the various chapters are the products of the several specialists and revisions have generally been made by the original author.

Care has been taken to maintain a logical arrangement of the data. Briefly the points covered are: Consideration of the required system, the figuring of heat losses, choice of proper equipment for heating by steam, hot water or warm air with various fuels, automatic heat control systems, ventilation, air conditioning, exhaust and collecting systems and refrigeration.

No doubt in later editions the data will be made more comprehensive. In the present edition such important developments as the "adhesive" types of air filters, also unit ventilators and unit heaters, are wholly ignored, while less than two pages are devoted to domestic oil burning.

Two of the most notable chapters are those on "Pipe Sizes for Steam Heating," by R. V. Frost, of Norristown, Pa., and on "Pumps for Heating and Ventilating Equipment," by Perry West, of Newark, N. J., and R. H. Carpenter, of New York. A valuable chapter on "Refrigeration" is contributed by Lee Nusbaum, of Philadelphia.

The data on "Ventilation" are particularly well arranged and the writers are on firm ground in basing their data throughout on the society's Synthetic Air Chart. In this and other sections some of the most recent and most important work of the society's Research Laboratory is incorporated, bringing these sections quite up-to-date.

The manufacturers' catalog data give the necessary information on the products of no less than 124 manufacturers of heating, ventilating and air conditioning apparatus.

Size 6 x 9 in. Pp. 518, bound in blue cloth, stamped in red and gold. Published by the American Society of Heating and Ventilating Engineers, 29 West 39th Street, New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE. Price $3.00 post-paid.

SMOKE ABATEMENT, a study of the police power as embodied in laws, ordinances and court decisions, is the title of a publication which will be welcomed by those interested in this subject. It is published under the authorship of Lucius H. Cannon, librarian of the St. Louis Municipal Reference Library, by the St. Louis Public Library. As is stated in the introduction, the department enforcing smoke ordinances varies. In New York, Chicago, Baltimore and some other cities it is under the supervision of the health department. In Philadelphia it is under the boiler inspection department. In Denver the building inspector performs the duties required by the ordinance. In Cincinnati it is an independent department. In Columbus, O., it is a division of the department of public safety. In Toronto, Canada, the department of public property has charge of smoke regulation. Numerous court decisions are given in the manual and their interest is enhanced by placing them, when available, in connection with the statistics and ordinances of the cities wherein the cases originated.

In the arrangement of the manual the data and court decisions pertaining to each city are placed in order, the cities covered including St. Louis, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Des Moines, Detroit, Indianapolis, Kansas City, Mo.; Los Angeles, Louisville, Madison, Wis.; Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Rochester, N. Y.; St. Paul, Salt Lake City, San Francisco, Washington, Wilmette, Ill.; London, England; Manila, P. I.; Montreal and Toronto, Canada.

Another section is devoted to digests of the laws of certain States, Canada, England and Germany on the subject of smoke abatement. The State laws quoted are those of California, Iowa, Louisiana, Massachusetts, Missouri, New Jersey, New York, Ohio, Pennsylvania, Rhode Island and Wisconsin. The manual concludes with a selected list of books and articles, chiefly those printed since 1913, followed by an index. Size 6 x 9 in. Pp. 207 to 318. Price 50 cents.

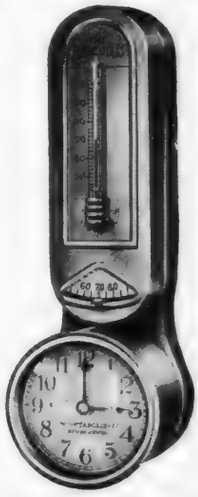
HOUSEHOLD PHYSICS, by Walter C. Whitman, editor of the *General Science Quarterly*, and head of the Department of Science, State Normal School, Salem, Mass., takes up the fundamental principles of physics, and applies them to household equipment. These principles are illustrated by applications and problems taken from the household. At the end of each chapter a complete summary is given of the subject just completed and suggestions for further study are included.

SOLVING THE NATION'S HEATING PROBLEM is the title of an article by George Harrison Agnew, reprinted from *The Plumbers' Trade Journal*, and devoted to the Institute of Thermal Research of the American Radiator Company. The article is supplemented with numerous illustrations, both of the institute and of its director, Frank B. Howell, and of various test set-ups for testing boilers, blast heaters, direct radiators and different heating specialties, including metallic bellows regulators. The company extends a cordial invitation to heating contractors, engineers and architects to visit the laboratories and offers to explain features and performance characteristics of its heating products, or to serve in other ways. "We want your ideas and suggestions," continues the invitation, "for improving our service. We want to compare notes with you from your experience in the field, introduce improvements and raise scientific standards wherever possible."

New Apparatus and Appliances

New Heat Regulator Models of Improved Design

Announcement is made by the Minneapolis Heat Regulator Co., Minneapolis, Minn., of two new models of heat regulators, including Model 77 8-day thermostat, with seven-jewel clock, and a new electric motor. An entire floor has been added to the company's factory to accommodate a modern and model clock factory, equipped to manufacture the highest type of jeweled clock. Each clock will have seven ruby and sapphire jewels, with a compensated balance adjusted to isochronism, heat and cold, and with a double roller, closely timed and regulated. All pinions and pivots, it is stated, are highly machined, and the clock is rendered sturdy by having extra plates and

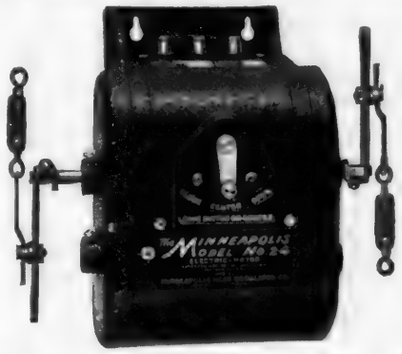


New Model 77 Eight-day Thermostat

posts. It is guaranteed against defects in workmanship and material for a period of five years.

Regarding the thermostat itself, the day and night action of the thermostat indicator is made independent of the main spring and time train of the clock, so that this action in no way affects the time-keeping qualities of the clock. The entire tripping mechanism is contained within the clock, giving this instrument the advantages of the duplex thermostat, at the same time retaining the simplicity of the one-day model.

The entire operation of throw adjustment to day and night temperatures has been simplified. A key set is provided for day and night regula-



New Type of Electric Motor for Use With Minneapolis Eight-day Thermostat

tion, a glance at the pointers giving a check-up on the temperatures for which the thermostat is set. The thermostat indicator can be changed manually at any time or to any degree without disengaging clock control, and without changing the day and night temperatures set.

The company's new A. C. electric motor (Model No. 24) is built upon the same basic principles as the old Minneapolis electric motor which, the company states, was the first electric heat regulator motor to be approved by the Underwriters' Laboratories. The new motor has a reserve power considerably exceeding the lifting demands of dampers or valves. A small transformer is used, which serves to prevent the motor from consuming current when not in operation, and also to supply a secondary low-voltage circuit of 8 volts through the thermostat, in that way preventing injury to the platinum-iridium. Both motor and transformer are contained in a die-cast, dust-proof aluminum housing, finished in black, with nickel trimmings.

The new motor is known as Type BTA and is available for use on three-phase, 60-cycle circuits at 220, 440 or 550 volts. It is commonly built for a three-to-one speed range and is rated on a constant torque basis, which horsepower output directly proportional to speed. The motors now being marked range from 3/1 H. P., 1650/550 R. P. M. to 50/16.7 H. P., 1250/415 R. P. M., the lower horsepower sizes being six-pole machines and the larger, eight-pole.

Among the applications for which the BTA motor is recommended by the manufacturers are boiler-house fans, and centrifugal compressors and pumps.

An Improved Fan Engine Regulator

The fallacy of the straight line chart for keeping boiler pressure constant, especially where there is a wide variation in demand, has been pointed out and generally agreed upon. The exact amount of steam required to drive the fan engine or blower is seldom known and it is seldom clear just what change in boiler pressure should be required before the regulator is opened fully and the fan engine brought from idling to full speed.

With these ideas in mind the A. W. Cash Co., Decatur, Ill., has brought out an improved fan engine regulator that is claimed to be notably accurate and sensitive, controlled by varying boiler pressure and bringing about compensating changes in fan or blower speed smoothly and evenly.

As shown in Fig. 1, the boiler-pressure connection and diaphragm, with self-aligning hardened-steel knife-edge bearing mounted on it, are unbolted and dropped down from their position in the device. Boiler pressure is at all times effective on the underside of the diaphragm. It is counterbalanced by the weighted beam which transmits the pressure change impulses through a link, seen in Fig. 2 to the balanced valve which supplies steam to the fan engine. Any decrease in boiler pressure causes a downward movement of the beam, an increase in valve opning, and therefore a gradual pick-up in fan speed. An increase in boiler pressure decreases the valve opening and decreases the fan speed until the fan is idling, when normal boiler pressure is reached. Each definite change in boiler pressure is therefore accompanied by a definite change in fan speed, which may be repeated every time.

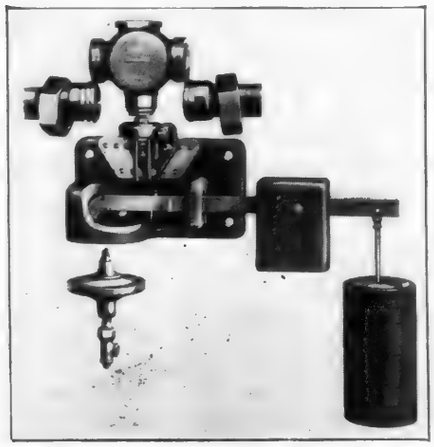


Fig. 1—Fan Engine Regulator Controlled by Varying Boiler Pressure

Assuming that good engineering requires an operating range of, say, 6 lbs. on a certain installation, if the desired normal boiler pressure is 180 lbs., the fan engine should be idling at that point and for economical reasons be brought up to full speed only when boiler pressure drops to 174 lbs., should it fall that low. There should be a lag between the boiler-pressure curve and the fan-speed curve.

With this device, it is stated, the amount of valve opening for a given change in pressure may be determined by the position of the valve in relation to the beam. With expansion joints installed before and after the balanced valve it may be shifted along the positioning pad and the connecting link connected to the beam at the corresponding hole. In this way a definite, fixed amount of valve travel may be established in relation to a definite, fixed and scientifically-desirable change in boiler pressure.

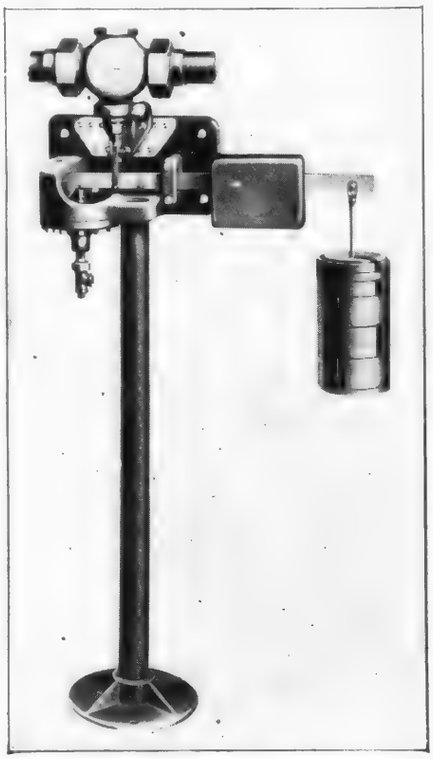


Fig. 2—Fan Engine Regulator Showing Link Connection to Balanced Valve

Rotostat Sling Psychrometer

The sling psychrometer is, of course, recognized as the standard instrument for measuring relative and absolute humidities. A rugged psychrometer designed especially for heating and ventilating engineers is now offered by the Rotostat Instrument Co., 220 North Thirteenth St., Philadelphia, Pa. To withstand the severe service to which it is subjected by travelling engineers, blower and air washer salesmen, and consulting engineers, the entire instrument except the spindle, is constructed of aluminum and brass, for lightness and resistance to corrosion. Although made for hard work and without unnecessary refinement, the instrument is said to be exceptionally accurate. The thermometers are hand-graduated, and are guaranteed accurate to ½° F. Matched pairs, serially numbered, are selected for each psychrometer. Because of large bulbs and small bores, the thermometers are very sensitive. This, together with the 16½ inch swinging radius, insures the maximum wet-bulb depression necessary for accuracy. The baked crystal lacquer finish supplies a black background for rapid reading of thermometers. When not in use the thermometer section is housed in the tubular body. The instrument is then a convenient size for the pocket or brief case. Thermometer breakage is minimized by the protection afforded by the tube.

In Use Closed

Rotostat Sling Psychrometer

New Electric Pipe Threader

A new electric pipe-threader designed to reduce the time and cost of pipe threading, has just been placed upon the market by the Oster Mfg. Co., Cleveland, O.

It is claimed that this motor-driven threader turns out more work in less time and with less effort at half the cost of production than the old method of hand turning. The machine is built to do the toughest kind of pipe threading and pipe cutting, and may be used on ¼ in. to 2 in. piping.

A built-in vise, aided by an auxiliary chuck, both of which are self-centering and self-locking, are used to hold the pipe in place while the die-stock is being turned by the motor. In addition to threading the pipe this machine does the cutting off and the screwing up of the fitting. The gears are completely encased and are run in oil.

The machine is driven by a ⅓ H. P. Westinghouse motor which is furnished with a 10-ft. cord and a screw plug which may be screwed into an ordinary light socket.

New Design of Electric Pipe Threader

The machine is portable and may be mounted on a service truck, eliminating the necessity of bringing each piece to the workshop to be threaded.

Improved Actuating Movement for Recording Instruments

New developments in recording instrument construction are announced by the Foxboro Co., Inc., Foxboro, Mass., consisting of an improved actuating movement of the helical-tube type. While the Foxboro engineers, it is stated, have been at work upon this movement for years, it was only recently that manufacturing methods had been worked out that assure accurate reproduction of the original movement in quantity.

The novelty of the new movement lies in the method of drawing, shaping and tapering the helical tube (Fig. 1) which, as in all recording instruments, is the vital part of the movement. This method makes possible a tube having several remarkable properties, affecting not only the performance of the instrument, but the entire design of the movement. The most important characteristic of the helical tube is that it is permanent in calibration. Test equivalent to years of service, it is stated, have not indicated any sign of fatigue in these tubes.

From the standpoint of design it has become possible to dispense with numerous adjustments. The manufacture of these tubes, it is stated, has been so perfected that every tube has known characteristics, so that it is possible to substitute one movement for another without recalibration.

The helical tube movement is also notable for its strength. In the test illustrated in Fig. 2, a 12-in. chart was placed on the regular 8-in. recording gauge and the pressure raised until the pen moved to the outer edge of the 12-in. chart. This is equivalent to an overload of 100%. The chart record showed that when the pressure was reduced to zero, the pen returned at once exactly to zero, indicating that the tube was not set.

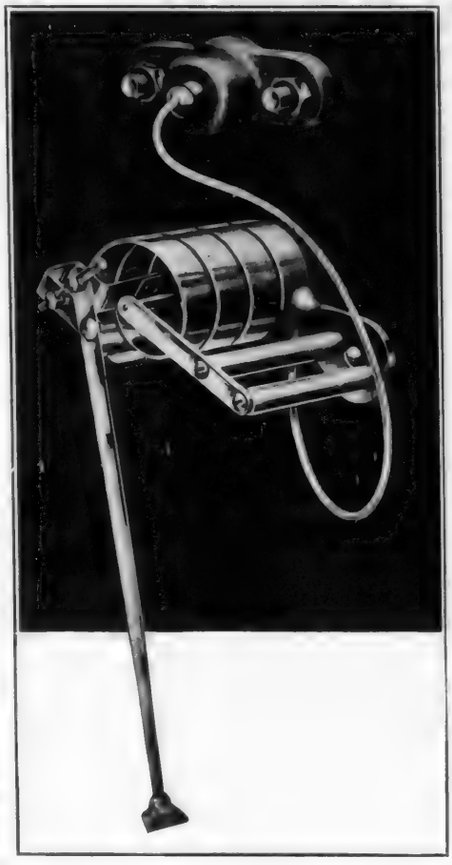


Fig. 1—Design of Helical Tube Movement in New Foxboro Recording Instrument

In another case, where a record of pressure was kept in a Jefferson Vomiting Kier, at the Lincoln Bleachery, Lonsdale, R. I., it is estimated that the pen arm moved up and down 16,000 times a month. No sign of weakening or loss of accuracy was observed in the movement of several Foxboro recorders after several months of continuous service. Thus no limited "working range" is specified with the new instruments, as the ordinary scale restrictions are found to be unnecessary.

The construction, it will be noted, provides a fixed axis of rotation for the pen arm so that it always follows the arc of the chart. This, it is pointed out, adds to the accuracy of the instrument, which has been found to be within 1% of total scale readings at all points of the scale and for all scale ranges. The compactness of the movement makes possible the use of the standard round form case illustrated in Fig. 3.

Fig. 2—Test of Helical Tube Movement at 100% Overload

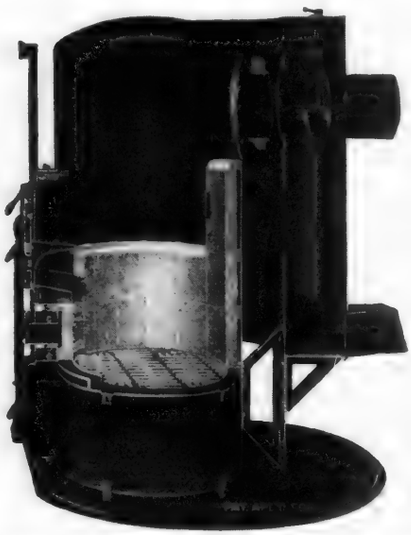
Fig. 3—How a Helical Tube is Adapted for Use in Standard Round Form Case

New Ideas Embodied in a Steel Warm Air Heater

Based upon the idea that smooth, vertical lines in parallel section with the body and casing furnish the best means of heat transference in a warm-air furnace, Dr. John P. Wagner, president of the Dowagiac Mfg. Co., Dowagiac, Mich., successor to the Dowagiac Drill Company and the Furnace Fan Co., has perfected a new type of steel warm-air furnace which this company has just placed on the market.

The heater is constructed of copper bearing-steel sheets or plates, where castings are used, they are of gray iron. The warm-air chamber bottom is made in one piece to which is welded a steel angle, forming the lower ring of the outer casing, preventing any leakage into the warm-air chamber from the cellar floor. A slotted pocket is provided by an additional angle bar for receiving the lower edge of the steel front. Location plates are welded to this bottom for properly locating the body of the heater.

The body of the heater has welded into it a heavy steel bottom forming the bottom of the ash-pit. Steel legs are welded to the bottom of the heater, thereby raising it 1½ in. from the bottom of the warm-air chamber, permitting the free passage of air under the ash-pit.



New Type of Steel Warm Air Furnace

The head is made of heavy plate welded to the shell of the heater. The shell of the heater is also made from heavy plate to which the feed pouch, ash-pit pouch and air-blast pouch are welded.

Steel sheets are used in the construction of the crescent radiator. The bottom and head, rear smoke flue and clean-out pouch are welded to the radiator.

Probably the most outstanding feature of this new heater is the connection of the front to the body of the heater by means of divided pouches, the front half of the pouches being welded to the front and constructed to prevent radiation into the basement through the front. The connection is made with flanges having bulb edges. The faces of the flanges are disc ground and fastened together by means of U-bar clamps at top, bottom and sides to form a tight, metal-to-metal joint without cement or bolts.

Among other notable features of this heater is its double-sealed feed door. A carburetor or tuyere forms the inner lining of the door into which air is admitted through a slide plate in the outer door. A device is provided for the opening of the draft damper in the radiator simultaneously with the opening of the feed door, automatically closing when the feed door is closed.

Locomotive rocker-type grate bars, self-locking in their bearings, are used. The fire-pot itself is lined with curved, corrugated fire-brick and an extra row of brick is inserted extending up to the throat of the flue outlet.

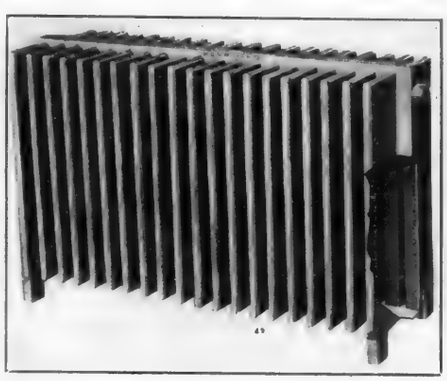
A water tank for supplying humidity to the air is provided which can be controlled from the rooms above.

New Trade Publications

IN TWO OF CHICAGO'S NEWEST HOTELS is the title of a folder issued by the Reed Air Filter Co., Inc., Louisville, Ky., calling attention to the selection of Reed air filters for the Edgewater Beach Hotel and the Allerton Club Hotel, in Chicago. The body of the folder is a reproduction of the company's advertisement in THE HEATING AND VENTILATING MAGAZINE for September.

HANDY REFERENCE BOOK is the title of a bound paper-covered manual of 215 pages issued by International Heater Co., Utica, N. Y. Its purpose is to provide the steam-fitter with a convenient pocket reference work. The contents are divided into four sections; boiler, repair, specialty and technical. The first section is made up of illustrations and tables of Economy boiler ratings and data necessary to establish such ratings. The repair section deals with price list of assemblies and unit parts with illustrations and descriptions. Specialties handled by the company are illustrated and explained in the following section. Specifications and capacities of radiators and unit ventilating systems are tabulated for the convenience of the dealer. The technical section gives useful tables and other data for use in figuring heating work.

KERRIHARD WROUGHT RADIATORS are described in a newly-issued circular of the Kerrihard Co., Red Oak, Iowa. In the manufacture of their DeLuxe oil-burning boilers, the process suggested a method of fabricating and welding Ingot Iron radiators and the wrought radiator is the result. For some time manufacturers have been trying to make a satisfactory radiator of some light material. Until the advent of electric and oxy-acetylene welding, the results, it is stated, were hazardous, due to difficulty in handling without pulling rivet heads and springing joints. The Kerrihard Company has tried to overcome this difficulty in their new product. The wrought radiators are made of Armco Iron and are specially flanged. They are tested to 30 lbs. and are recommended for a working pressure of 15 lbs. The weight is given as less than one third that of cast-iron. The large central port is designed to permit an unrestrained flow of heating fluid.

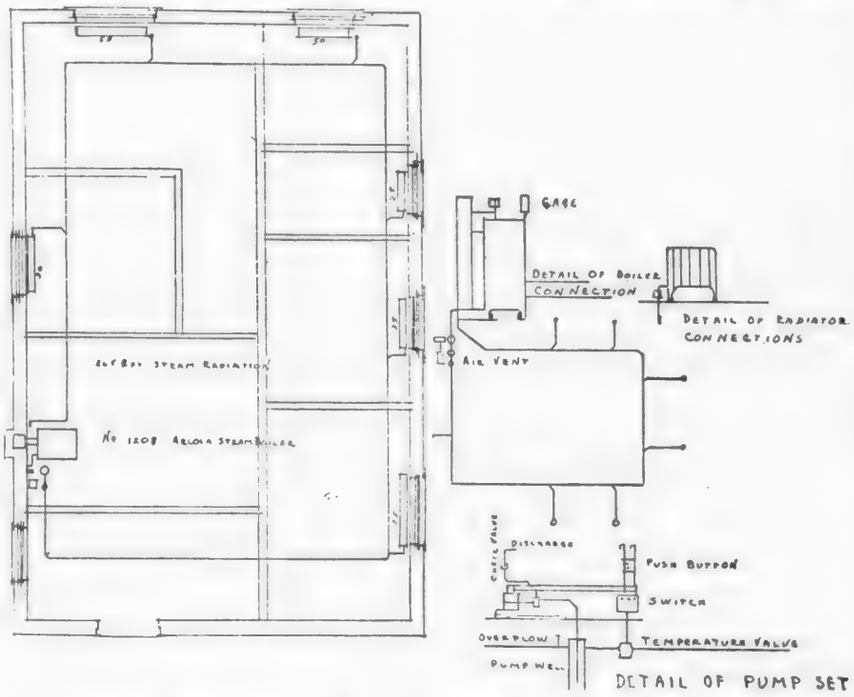


Design of Kerrihard Wrought Radiator

WEBSTER BOILER-RETURN TRAP, is the subject of Bulletin 726 issued by Warren Webster & Co., Camden, N. J. The boiler-return trap is designed for use, in combination with the Webster modulation system, widening the field of application of open-return-line systems and bringing about their general use under all sorts of operating conditions. The boiler-return trap combination, it is stated, is of particular advantage in Webster modulation systems where the pressure or static head due to the difference in level between the boiler water-line and the lowest point of the overhead dry-return main near the boiler is not sufficient to cause the condensation to return continuously to the boiler, when the pressure within the return is at or below atmosphere. The same bulletin describes also the Webster vent trap in Type R systems, which is also illustrated. This is designed to bring about the removal of air from the system independent of the operation of the trap. The body and cover are of cast-iron, the float is steel, heavily copper-plated, and all other interior parts are brass. Other new bulletins issued by this company are: 705-51, Webster Sylphon quick-opening valve Nos. 575 and 575W; 706-2, superseding 706-1 and describing the Webster heavy-duty traps; 703, the Webster vacuum-pump governor; 717, the Webster modulation vent trap; and 718, the Webster damper regulator.

Construction of Webster Boiler Return Trap

C. H. SYSTEM OF HEATING, designed to permit the use of radiation in bungalows and two-story buildings without cellars, at the same time insuring the return of the water of condensation to the boiler, thus insuring a dry system of steam heating, dispensing with overhead mains, expansion tank and excessive hot water radiation, is illustrated and described in newly-issued circular matter received from the Collins Plumbing & Heating Co., Houston, Texas. The device used to accomplish this result operates to pump the condensation from the steam mains below the boiler level back into the water-line without pitting the boiler. Through the use of a temperature valve, automatic control is applied to a small rotary pump, by means of the variation of the temperature in the return line. The valve is designed to open at 180° in the return pipe and close at 200°.

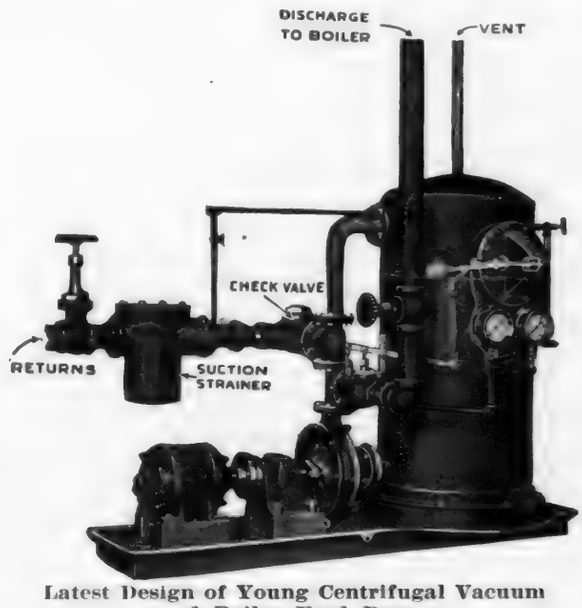


Typical Application of C. H. System of Heating to One-Pipe Gravity Steam Job

JOHNSON SYSTEM OF TEMPERATURE AND HUMIDITY CONTROL is the subject of a handsome catalogue, which rises to the dignity of an engineering manual, issued by the Johnson Service Co., Milwaukee, Wis. As stated in the foreword, the manual is intended to win a wider appreciation of the value and necessity of automatic temperature regulation, to show the part played by the Johnson Service Company in the invention and development of this art, and to describe in detail the various articles, such as thermostats, valves, dampers, air compressors, and humidostats made by the company, their functions and their qualities. The manual will be found interesting reading to owners and managers of buildings, as well as to architects and contracting engineers. To those who are not familiar with the history of temperature regulation, one of the most interesting sections is that devoted to this subject, with direct reference to the Johnson system, from the time of the original inventions of Professor Warren S. Johnson. The policy upon which the company has built up its present extensive business is explained, showing the importance of quality and reliability, thorough testing of apparatus, the maintenance of installations and the co-operation given the owner, architect and contractor. An impression of the variety of uses of the Johnson line is given in the manual. In addition to pneumatic and electric thermostats, including intermediate types, thermostats are shown for hot water control, ice water control, brine tank and refrigerator control, as well as a calibrated thermostat for controlling either gases or liquids. A hydraulic thermostat is also shown. Another section is devoted to the company's line of thermometers, Johnson metal diaphragm valves, Sylphon radiator valves, coil valves and seamless Sylphon metal bellows. The section on Johnson dampers covers single and double mixing dampers, round dampers and louvre dampers, all pneumatically controlled, while the section on air compressors includes those electrically and hydraulically and steam operated.

Under humidity control the Johnson System of humidity control is described at length, with separate descriptions of the company's Humidostat, perforated steam pipe humidifier, spray heads for fan-furnace heating plants, the Johnson pan humidifier, followed by typical views of numerous applications of complete heating, ventilating and humidifying systems. Size 8¼ x 11 in. Pp. 82.

YOUNG CENTRIFUGAL VACUUM AND BOILER FEED PUMP, manufactured by the Young Pump Company, Michigan City, Ind., is described in Bulletin No. 4, recently issued. While this pump is well known to the trade the new catalogue presents many interesting facts in connection with its operation and also offers some new photographic studies. The pump is described by the manufacturer as a "reliable vacuum system pump for handling both gases and liquids efficiently." The unit consists of a centrifugal pump, bronze fitted, of enclosed impeller and high-efficiency type, mounted together with an approved make of motor and heavy welded tank on a cast-iron base. A bronze bearing on each side of the pump impeller supports the pump shaft, which is made of Monel metal. In the discharge line of the pump is a balanced by-pass valve automatically controlled by a float within the tank, also the Young exhauster which discharges into the tank. Pressure and vacuum gauges are mounted on the tank.



Latest Design of Young Centrifugal Vacuum and Boiler Feed Pump

The Function of the Differential Loop in Vapor Heating

A frank discussion of the difficulties sometimes met with in connection with the operation of vapor heating systems and of the value of a differential loop in overcoming these troubles, is contained in a recent letter from P. J. Dougherty, formerly engineer for the International Heater Co., Utica, N. Y., written to George D. Hoffman, president of the Hoffman Specialty Company, after a visit to Mr. Hoffman's home and experimental laboratory in Pasadena, California.

"During the last 25 years," writes Mr. Dougherty, "I have had my share of grief with vapor systems in the way of burnt-out boilers on vapor systems, due primarily to too great a pressure differential between the flow and return side of the boiler and, secondarily, to automatic mechanical equalizing devices which failed to function when they should.

"In my experience the most serious troubles with vapor systems might be classed under the following five requirements: (1) the maintenance of a predetermined maximum pressure differential between the supply and return ends of the system; (2) the fool-proof action of a pressure-differential device; (3) the maintenance of uniform pressure throughout the entire length of the dry return main; (4) the modulation of heat in each radiator, independent of the boiler pressure; (5) the heating up of a cold radiator when turned on after the rest of the system is heated up."

Mr. Dougherty then took up the various requirements in order, showing how each requirement was met by the use of the differential loop.

Discussing Requirement 1, the maintenance of a predetermined maximum pressure differential between the supply and return ends of the system Mr. Dougherty stated that during the tests the Hoffman differential loop maintained a maximum pressure differential of 10 oz. between the flow and return end of the heating system when the boiler pressure was over 10 oz. The dry return main was 150 ft. long and the pressure at times on the boiler was up to 3 lbs., the maximum range of the mercury gauge on the boiler, a sectional cast-iron type, oil fired. Those tests, he added, demonstrated the positive action of the differential loop in maintaining a maximum predetermined pressure differential under forced firing conditions and excessive boiler pressures; the functioning of the loop when it should function, thus avoiding dangerous differential pressure conditions; and the return of the condensation to the boiler while the boiler pressure had risen to five times the maximum boiler pressure required, thus preventing the burning out of the boiler.

Regarding Requirement 2, the fool-proof action of the pressure differential device, he laid stress on the fact that the functioning of the differential loop is dependent solely upon the movement of a short fluid column, free from all moving parts, also to the manner in which the possibility of the fluid column and the seal being blown out of the loop under a sudden increase of the pressure differential, due to sudden closing off of a large bank of radiators, is provided against by steam baffles at the top of the loop.

To demonstrate the efficiency of these baffles as a means of retaining the water within the loop under extremely adverse conditions, a ¾-in. valve connected to the return main within 5 ft. of the loop was suddenly opened to the atmosphere when practically 1½ lbs. of pressure was on the boiler. Even then only a slight amount of water was blown out of the loop.

HOW UNIFORM PRESSURE IS MAINTAINED IN DRY RETURN MAIN

In connection with Requirement No. 3, the maintenance of uniform pressure throughout the entire length of the dry return main, Mr. Dougherty showed how it was as essential to maintain uniform heating conditions throughout a vapor heating system and proper modulation within each radiator with only a few ounces of pressure on the boiler as it was to maintain a uniform pressure between the boiler and the various radiators.

In his tests he found that when the boiler pressure was below 10 oz., atmospheric pressure was maintained in the dry return main through the ¾-in. opening of the return-main air-relief valve. When the boiler pressure went over 10 oz., the operation of the differential loop passed steam through the loop, which closed the thermostatic air-relief valve on the return main, thus sealing the system and raising the pressure of the dry-return main up to within 10 oz. of that of the supply main. Both the water and mercury column gauges at both ends of the 150 ft. of the dry-return main registered the same pressure during the various tests over a wide variation of pressures up to 500% of the maximum operating pressure required. The location of the differential loop near the boiler and at the highest point and at the beginning of the dry-return was found to be an important factor in maintaining a uniform pressure throughout the entire dry-return main.

While the boiler pressure was over 10 oz. the live steam passing through the loop sealed the system by closing the air relief valve, then compressed the air throughout the entire return main, instantaneously registering the same pressure on the mercury and water column gauges at both ends of the 150 ft. return main. As the boiler pressure kept increasing, the air pressure within the return main was uniformly increased by the admission of a small quantity of steam into the return main through the differential loop.

The small quantity of steam admitted into the return main at its high point remained packed there, merely compressing the air, with a negligible flow of either air or steam along the return main. Because of this negligible movement of steam and air within the return main, the total pressure remained uniform throughout the entire return main, since the velocity head drop was negligible. Uniform heating of all risers, and modulation control of each radiator, he showed, depends upon maintaining a uniform pressure on the supply side of each radiator valve by proper sizing of the supply mains and risers and the maintenance of a uniform pressure and differential in the return main.

MODULATING THE HEAT IN EACH RADIATOR

As Mr. Dougherty pointed out, in discussing Requirement 4, the modulation of heat in each radiator independent of boiler pressure within practical limits, this modulation is independent of boiler pressure, provided a maximum pressure differential is maintained in the system. In other words, modulation depends upon pressure differential, and not merely upon boiler pressure. A control valve that is designed to modulate steam in a radiator under a 10-oz. pressure differential will do so whether the pressure on the supply side is 10 oz. and on the return side is atmospheric, or whether the pressure on the supply side is 2 lbs. 10 oz., and on the return side 2 lbs. In both cases the maximum differential is 10 oz., which must not be exceeded in order to modulate heat in the radiator.

HEATING UP A COLD RADIATOR WITH SYSTEM IN OPERATION

Regarding Requirement 5, the heating up of a cold radiator when turned on after the rest of the system is heated up, the test made was to turn on such a radiator when the boiler pressure was 2 lbs. 12 oz., and the pressure on the return main 2 lbs. 2 oz., and the rest of the system heated up. The 10-oz. pressure differential and the fact that the return main and risers were filled principally with air under pressure, permitted the radiator gradually to heat up and expel the air into the return riser.

The opening of this radiator reduces the pressure differential enough to seal the loop and cut off the steam from the return air vent valve which soon cooled off and opened, permitting air to escape from the return main. This escape of air from the return main allowed the air to escape from the radiator being heated and reduced the pressure in the return main until it again became 10 oz. below the steam main, when the differential loop started to function and pass steam into the return main and sealed the system by closing the return air vent. The condensation of steam in the cold radiator repeated this same cycle of opening and closing the return air vent several times until the radiator was heated.

THE STATE OF BUSINESS

West Shows Marked Improvement

The Dangers of Too Much Saving—No Chance for a Boom

Especially Prepared for the THE HEATING AND VENTILATING MAGAZINE

By L. W. Alwyn Schmidt

SIGNS of a general broadening of the market situation are multiplying. Just now it is the West which is feeling the return of the buying movement. But there are, already noticeable, indications of greater strength also in the eastern industrial centers. The situation, however, although vastly improved, still requires considerable caution. The industrial wage earner and salaried man have been severely frightened by the sudden break of the market during Spring and will require very potent evidence of better times before they start to buy upon a larger scale.

There is no doubt that the campaign for greater economies carried on during the war as a war measure, and continued by the savings banks for their own benefit, has taken root and has brought about a habit of frugality, which, while swelling savings banks accounts, has had a depressing influence upon the merchandise turnover. Money invested in loan societies; life insurance and resting in banking accounts does not buy clothing, furniture or automobiles. This money is withdrawn from ordinary retail circulation. Its accumulation in the banks has had so far no other evident advantage but that of bringing down the discount rate.

As nobody needs money, there is nothing gained at present by letting grow the nation's financial reserve and business certainly would be better served if part, at least, of this money would be released for the purchase of merchandise.

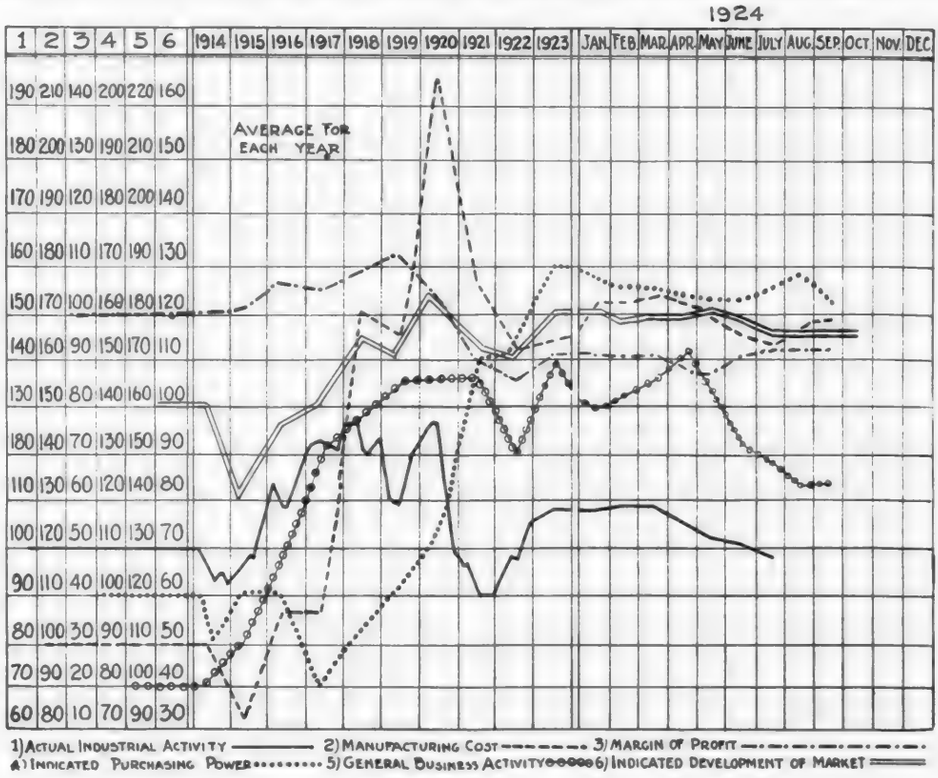
The truth of this is realized already by many students of the economic situation and proposals to accelerate the purchase movement by group advertising are a move in the right direction. But advertising alone cannot break the inertia of the retail buyer. More and stronger means are required to bring him into the market.

The lowering of prices by itself is no real inducement for the consumer. To make low prices effective the goods must appeal in style and usefulness to his immediate desires.

Until the right policy has been found, business will have to be satisfied with such demand as is caused by the ordinary needs of the market. And these needs are not large enough as to justify any wild hopes in the future of the market. There is no chance for a boom. But there is every hope for a steady all-round improvement.

Support is given to this view of the situation (1) by the improvement of the agricultural situation; (2) by the healthy condition of the national industry; (3) by actual evidence found by a study of the business activity in leading retail centres; the money situation and the condition of certain key industries.

There can be no dispute to-day any more over the healthy change that has come over the agricultural sections of the nation. The Northwest and Middle-west have shaken off their lethargy and money has flowed more freely in the rural communities. How long this condition will last must still be seen. To judge from reports from wholesale distributors the movement is still not


1924
1 2 3 4 5 6
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.
AVERAGE FOR EACH YEAR
1) ACTUAL INDUSTRIAL ACTIVITY
2) MANUFACTURING COST
3) MARGIN OF PROFIT
4) INDICATED PURCHASING POWER
5) GENERAL BUSINESS ACTIVITY
6) INDICATED DEVELOPMENT OF MARKET

Analysis of Business Conditions at End of September

strong enough to produce any market increase in retail orders. But, even so, it must have helped to clear the shelves of the country stores, turning into cash goods that had waited for such an opportunity since last Autumn. Orders for replacement must follow. It is, however, not certain that these orders will exceed in volume the usual quantities ordered around this time of the year. And it must be remembered that the market is not setting out for a boom, but merely attempting a return to normalcy.

These orders, nevertheless, are large enough as to bring a promise of employment to a large part of the national industry which has had a very trying Summer indeed. This employment will be the more appreciated as all orders appear to be based upon prices that leave a healthy profit to the manufacturer. In fact, statistics show that the industry has stood the crisis extremely well and is coming out of it with its earning power unimpaired. Allowing for a few exceptions manufacturing costs and wholesale prices have continued upon levels favorable to the manufacturer and the profits left from industrial production have shown no further decrease.

Speculation now is ripe as to the further development of the new buying movement. As stated before, it has taken its start in the agricultural West and is now working its way in the direction of the industrial centres. Larger sales by western department stores; heavy railroad loadings; favorable reports from mail-order houses show the widening radius of the new prosperity. The banks have had no difficulty in financing the crop movement and the reported increase in unfilled orders of the U. S. Steel Corporation shows that industry also is taking a more optimistic view of the situation.

There is, therefore, no lack of encouragement to those who are inclined to take an optimistic view of the situation. But there is still the danger that the present improvement will be of short duration only and will not be sufficiently strong to carry the market clear through the Christmas season into the New Year.

Taking everything into consideration we are inclined to think that there will be a downward movement after the crest of the present wave has been reached. This decline, however, will be slight and of short duration. It may be so insignificant in some industries as to be hardly noticeable and it will be counterbalanced in its effect upon the national market by a rise in such industrial branches which, until now, have been kept outside the range of the economic recovery.

Any further downward movement, therefore, should not have any depressing effect upon enterprise. But its possibility should be sufficient to caution those who, encouraged by the favorable money situation, see the coming of a boom in the slightest ripple upon the sea of our prosperity. There is no chance for such an eventuality and, still more, it is not wanted. But it will take all the good sense of the financial interests to check the bulls if by chance they should see their opportunity and get beyond control. The expected placing of the German Dawes Plan Loan happily is likely to provide for a safety valve by which we can relieve the country of some of the steam pressure caused by an oversupply of ready cash.

The situation is bound to remain full of exciting possibilities until after the election.

Ventilating Vagaries

A Missouri heating engineer recently sent in this contribution which he says was actually used in a specification for a school heating installation. It follows without editorial corrections or comments:

There was a bird who had a hunch
That he was an engineer
So he played it strong with results
You see are given here.

"When the weather is sufficiently warm that heat is not required, the blower will be stopped, the windows will be opened and God will ventilate the rooms, (except the toilet rooms)."

How Chicago Theaters Are Ventilated

In connection with a study of theater ventilating practice in different sections of the country, a letter from Dr. E. Vernon Hill, of Chicago, states that there is no single system in favor at the present time in that city. The Chicago Theater, as well as the Tivoli, Central Park and Riviera use the floor mushroom introduction. This type of inlet has given satisfaction for heating purposes but in summer, when refrigerated air is admitted, complaints are heard from theater patrons. The proximity of the mushrooms to the feet of the patrons has proven objectionable. McVicker's Theater has recently installed a ventilating system which is very satisfactory. Side wall introduction is used with floor exhaust on the main floor and ceiling exhaust in the balcony. The owners believe that they have the most efficiently artificially cooled theatre in the country.

There are no theaters in Chicago at the present time that have adopted the overhead supply and floor exhaust system, such as is used in the Grauman Theater in Los Angeles. According to Dr. Hill, it has been conceded by Chicago engineers that the mushroom introduction is not satisfactory but they are still undecided if overhead supply is superior to sidewall introduction. Dr. Hill, in three Chicago theaters for which he is designing ventilating systems, has favored side-wall air supply for the most part, with ceiling inlets in the balconies. In the three installations floor exhausts will be used entirely.

Garage Ventilation

The increasing demand for parking space in mid-city sections, together with the blockading of streets, has made it imperative for police departments to regulate parking time of standing automobiles. The considerable inconvenience these regulations are causing the owners of both pleasure and commercial cars has in turn given rise to an insistent demand for mid-city parking garages.

Because these garages must be located in congested sections, artifically-induced ventilation of these buildings, to rid them of the obnoxious gases emitted by cars entering and leaving, has become a matter for serious consideration.

The following is the manner in which the ventilating problem was solved by one of the most modern garages in the world, recently opened to the public:

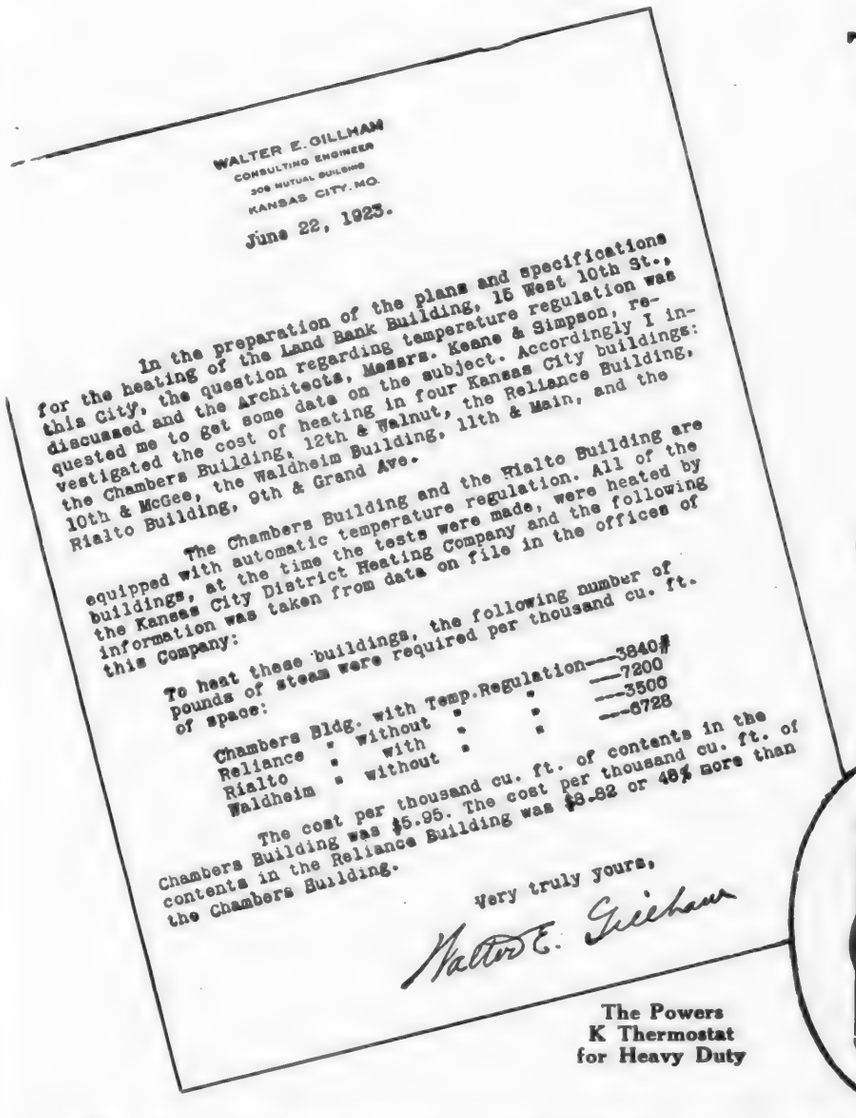
A ventilating shaft was located approximately in the center of the building. At the top of the shaft a large suction fan was placed. Adjustable louvers were located in the shaft near the ceiling of each story. The fan produced a partial vacuum in the shaft, causing the used air to flow into the shaft and out at the top. By means of the adjustable louvers, control over the individual story is effected.

The proper location for the louvers at each story should receive especial consideration. It has been found that, where the ventilating shaft is located in the center of the building, away from the windows, most efficient ventilation is secured in the summer time, by placing the louvers at the ceiling, as the gases emitted by the motors are hot and will immediately rise to the ceiling.

In the winter time, however, the natural circulation in the building will be upward at the windows, across the ceiling toward the center of the building and thence downward and along the floor to the windows. With the flow as described it is advisable to locate the louvers in the shaft at or near the floor, provision also being made for exhausting a small quantity of air near the ceiling.—*The Architect and Builder.*

Mechanical Equipment of the Tribune Building, Chicago

The fame already achieved by the new Chicago Tribune Building, which has become a dominating feature of the sky-line of the Windy City, lends special interest to the fact that Mehring & Hanson Co., of Chicago, was the heating contractor for this building. In a recent advertisement in these columns featuring the use of Buffalo fans and Carrier air washers in this building, the name of the heating contractor was mis-spelled.



WALTER E. GILLHAM
CONSULTING ENGINEER
309 MUTUAL BUILDING
KANSAS CITY, MO.

June 22, 1923.

In the preparation of the plans and specifications for the heating of the Land Bank Building, 15 West 10th St., this City, the question regarding temperature regulation was discussed and the Architects, Messrs. Keane & Simpson, requested me to get some data on the subject. Accordingly I investigated the cost of heating in four Kansas City buildings: the Chambers Building, 12th & Walnut, the Reliance Building, 10th & McGee, the Waldheim Building, 11th & Main, and the Rialto Building, 9th & Grand Ave.

The Chambers Building and the Rialto Building are equipped with automatic temperature regulation. All of the buildings, at the time the tests were made, were heated by the Kansas City District Heating Company and the following information was taken from data on file in the offices of this Company:

To heat these buildings, the following number of pounds of steam were required per thousand cu. ft. of space:

Chambers Bldg. with Temp.Regulation	3840#
Reliance " without " "	7200
Rialto " with " "	3500
Waldheim " without " "	6728

The cost per thousand cu. ft. of contents in the Chambers Building was $5.95. The cost per thousand cu. ft. of contents in the Reliance Building was $8.82 or 48% more than the Chambers Building.

Very truly yours,

Walter E. Gillham

The Powers
K Thermostat
for Heavy Duty

This Test Shows

48 per cent Saving of Steam with POWERS temperature control

Does automatic temperature control in Workrooms, Offices, Schools, etc., really pay?

The proof shown in the above test is typical of many others which have shown remarkable savings of fuel with Powers automatic temperature control.

Tests show that the majority of workrooms are overheated. Eliminate overheating with Powers temperature control, and you improve the health and increase the output of workers. The effect overheating has on the output of men is shown in the report of the New York State Commission on Ventilation, which says:

"An increase of room temperature from 68° F. to 75° F. caused a decrease of 15 per cent in the physical work performed by men who were not compelled to maximum effort but were stimulated by a cash bonus."

Partial List of Users

Sears Roebuck & Co.
U. S. Rubber Co.
B. F. Goodrich Co.
Eastman Kodak Co.
American Woolen Co.
E. I. DuPont de Nemours Co.
J. T. Ryerson Co.
Crane Co.
Carson Pirie Scott & Co.
Wm. Wrigley, Jr. Co.
DuPont Fabrikold Plant
Hartford Fire Ins. Co.
Willys-Overland Co.
Julius Kayser Co.
New England Tel. & Tel. Co.
Walter Baker & Co.
Phoenix Mutual Life Ins. Co.
Rothacker Film Co.
B. & O. Railway
Yellow Cab Mfg. Co.
Irving Pitt Mfg. Co.
Fleischmann Co.
Federal Reserve Bank, Kansas City, Mo.
Larkin Soap Co.
Consolidated Gas Co., New York City
Chicago Telephone Co.
Yale University
Princeton University

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Our book, "THE ELIMINATION OF HEAT WASTE," shows how and why a Powers System of Temperature Control gives such remarkably long and accurate service, and why its high first cost is cheapest in the end. May we send you a copy?

THE POWERS REGULATOR COMPANY

33 years of specialization in automatic temperature control

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Boston
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Cleveland
Denver
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El Paso
Houston
Indianapolis
Kansas City
Los Angeles
Milwaukee
Minneapolis
Nashville
New Orleans
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Philadelphia
Pittsburgh
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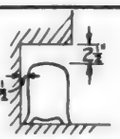
2450 A

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

One-Column Steam, Recessed

1 COLUMN RADIATOR



STEAM AT 215°F.
RECESSED RATING

SECTIONS	LENGTH IN INCHES	38"		32"		26"		23"		20"	
		Actual Surface	Equivalent surface at 250 btu. per sq. ft	Actual Surface	Equivalent surface at 250 btu. per sq. ft.	Actual Surface	Equivalent surface at 250 btu. per sq. ft	Actual Surface	Equivalent surface at 250 btu. per sq. ft	Actual Surface	Equivalent surface at 250 btu. per sq. ft.
2	5	6	7.0	5	6.1	4	4.1	3⅓	4.3	3	3.8
3	7½	9	9.5	7½	8.3	6	6.8	5	5.8	4½	5.3
4	10	12	12.0	10	10.3	8	8.5	6⅔	7.3	6	6.6
5	12½	15	14.5	12½	12.5	10	10.3	8⅓	8.8	7½	8.0
6	15	18	17.1	15	14.8	12	12.2	10	9.4	9	9.3
7	17½	21	19.6	17½	16.1	14	13.9	11⅔	11.8	10½	10.9
8	20	24	22.2	20	19.2	16	15.8	13⅓	13.4	12	11.2
9	22½	27	24.7	22½	21.4	18	17.6	15	15.0	13½	13.7
10	25	30	27.3	25	23.3	20	19.0	16⅔	16.6	15	15.0
11	27½	33	29.8	27½	25.8	22	21.2	18⅓	18.1	16½	16.6
12	30	36	32.4	30	28.0	24	22.3	20	19.6	18	18.3
13	32½	39	34.1	32½	30.3	26	24.8	21⅔	21.2	19½	19.3
14	35	42	37.4	35	32.5	28	26.6	23⅓	22.7	21	20.6
15	37½	45	40.1	37½	34.7	30	28.5	25	24.2	22½	22.1
16	40	48	42.5	40	36.8	32	30.3	26⅔	25.8	24	23.5
17	42½	51	44.9	42½	39.1	34	32.0	28⅓	27.3	25½	25.2
18	45	54	47.4	45	41.1	36	33.9	30	28.8	27	26.1
19	47½	57	50.1	47½	43.4	38	36.8	31⅔	30.4	28½	27.7
20	50	60	52.5	50	45.6	40	37.6	33⅓	31.9	30	29.0
21	52½	63	54.9	52½	47.6	42	39.2	35	33.4	31½	30.4
22	55	66	57.5	55	49.9	44	41.1	36⅔	35.3	33	31.8
23	57½	69	59.9	57½	51.1	46	42.9	38⅓	36.4	34½	33.2
24	60	72	62.3	60	54.2	48	45.1	40	38.0	36	34.5
25	62½	75	64.9	62½	56.2	50	46.5	41⅔	39.4	37½	36.0
26	65	78	67.5	65	58.2	52	48.2	43⅓	40.7	39	37.5
27	67½	81	70.0	67½	60.8	54	50.1	45	42.5	40½	38.7
28	70	84	72.4	70	62.7	56	51.8	46⅔	43.1	42	40.1
29	72½	87	74.6	72½	64.8	58	53.4	48⅓	45.4	43½	41.5
30	75	90	77.2	75	67.0	60	55.2	50	46.1	45	42.7
31	77½	93	79.4	77½	68.1	62	56.9	51⅔	48.3	46½	44.0
32	80	96	81.1	80	71.3	64	58.7	53⅓	49.9	48	45.4
33	82½	99	84.2	82½	72.1	66	60.3	55	51.3	49½	46.7
34	85	102	86.8	85	75.3	68	62.2	56⅔	52.7	51	48.0
35	87½	105	88.9	87½	77.3	70	63.7	58⅓	54.2	52½	49.3
36	90	108	91.5	90	79.4	72	65.6	60	55.7	54	50.7
37	92½	111	93.6	92½	81.3	74	67.1	61⅔	57.0	55½	52.2
38	95	114	96.1	95	83.5	76	68.9	63⅓	58.6	57	53.3
39	97½	117	98.4	97½	84.4	78	70.5	65	59.9	58½	54.7
40	100	120	100.8	100	86.5	80	72.3	66⅔	61.4	60	56.2

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RADIATOR RATINGS—1-COL. STEAM, RECESSED | No. 14-L

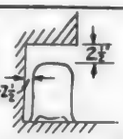
Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

Two-Column Steam, Recessed

2 COLUMN RADIATOR 2"w 2½"



STEAM AT 215°F.
RECESSED RATING

SECTIONS	LENGTH IN INCHES	45"		38"		32"		26"		23"		20"	
		Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft.	Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft.	Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft.	Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft.	Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft.	Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft.
2	5	10	10.6	8	8.8	6⅔	7.1	5⅓	6.1	4⅔	5.5	4	4.7
3	7½	15	14.5	12	11.9	10	10.2	8	8.2	7	7.5	6	6.6
4	10	20	18.2	16	14.1	13⅓	12.8	10⅔	10.8	9⅓	9.4	8	8.3
5	12½	25	21.9	20	17.1	16⅔	15.7	13⅓	12.9	11⅔	12.4	10	9.1
6	15	30	26.3	24	21.4	20	18.3	16	15.3	14	13.5	12	11.7
7	17½	35	29.9	28	24.8	23⅓	21.1	18⅔	17.6	16⅓	15.5	14	13.5
8	20	40	33.8	32	27.8	26⅔	25.9	21⅓	19.8	18⅔	17.5	16	15.3
9	22½	45	37.7	36	30.9	30	26.7	24	21.9	21	19.6	18	17.1
10	25	50	41.7	40	33.2	33⅓	29.4	26⅔	24.3	23⅓	21.5	20	18.9
11	27½	55	45.5	44	37.3	36⅔	32.1	29⅓	26.3	25⅔	23.6	22	20.6
12	30	60	49.3	48	40.6	40	34.7	32	28.6	28	25.5	24	22.4
13	32½	65	53.3	52	43.7	43⅓	37.5	34⅔	30.7	30⅓	27.4	26	24.6
14	35	70	57.1	56	46.8	46⅔	40.2	37⅓	32.1	32⅔	29.5	28	25.8
15	37½	75	61.4	60	50.0	50	42.9	40	35.2	35	31.4	30	27.6
16	40	80	64.6	64	53.0	53⅓	45.6	42⅔	37.4	37⅓	33.4	32	29.4
17	42½	85	68.4	68	56.2	56⅔	48.2	45⅓	39.5	39⅔	35.3	34	30.1
18	45	90	72.4	72	59.5	60	50.8	48	41.9	42	37.4	36	32.8
19	47½	95	76.2	76	62.7	63⅓	53.7	50⅔	43.9	44⅓	39.2	38	34.2
20	50	100	79.7	80	65.4	66⅔	56.2	53⅓	46.2	46⅔	41.3	40	36.1
21	52½	105	83.7	84	68.7	70	58.1	56	48.3	49	43.3	42	38.0
22	55	110	87.4	88	71.7	73⅓	61.6	58⅔	50.6	51⅓	45.3	44	39.6
23	57½	115	91.5	92	74.9	76⅔	64.5	61⅓	52.9	53⅔	47.2	46	41.4
24	60	120	94.1	96	77.9	80	67.0	64	55.0	56	49.0	48	43.1
25	62½	125	98.7	100	81.3	83⅓	69.7	66⅔	57.1	58⅓	50.9	50	44.9
26	65	130	102.3	104	84.1	86⅔	72.1	69⅓	59.6	60⅔	53.6	52	46.6
27	67½	135	105.9	108	87.2	90	75.0	72	61.4	63	55.1	54	48.2
28	70	140	109.6	112	89.1	93⅓	77.3	74⅔	63.9	65⅓	56.9	56	50.0
29	72½	145	113.6	116	93.4	96⅔	80.3	77⅓	65.9	67⅔	58.7	58	51.6
30	75	150	117.1	120	96.1	100	82.6	80	67.8	70	60.6	60	53.3
31	77½	155	120.9	124	98.9	103⅓	85.4	82⅔	69.6	72⅓	62.3	62	54.6
32	80	160	123.7	128	102.1	106⅔	87.7	85⅓	72.0	74⅔	64.3	64	56.3
33	82½	165	127.4	132	104.8	110	89.1	88	73.9	77	66.0	66	58.0
34	85	170	131.3	136	107.9	113⅓	92.8	90⅔	75.8	79⅓	67.1	68	59.8
35	87½	175	134.6	140	110.5	116⅔	95.2	93⅓	78.1	81⅔	69.7	70	61.3
36	90	180	138.9	144	113.7	120	97.9	96	80.3	84	71.7	72	63.0
37	92½	185	142.3	148	116.8	123⅓	100.6	98⅔	82.5	86⅓	73.8	74	64.8
38	95	190	145.3	152	119.4	126⅔	102.8	101⅓	84.7	88⅔	75.6	76	66.4
39	97½	195	149.3	156	122.8	130	105.6	104	86.7	91	77.4	78	68.0
40	100	200	153.1	160	126.0	133⅓	108.2	106⅔	89.0	93⅓	79.4	80	69.6

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RADIATOR RATINGS—2-COL. STEAM, RECESSED | No. 14-M

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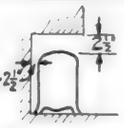
THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

Three-Column Steam, Recessed

3 COLUMN RADIATOR 2 or 2½"  2½" STEAM AT 215° F **RECESSED RATING**

SECTIONS	LENGTH IN INCHES	45" Actual Surface	45" Equivalent surface at 250 btu per sq ft	38" Actual Surface	38" Equivalent surface at 250 btu per sq ft	32" Actual Surface	32" Equivalent surface at 250 btu per sq ft	26" Actual Surface	26" Equivalent surface at 250 btu per sq ft	22" Actual Surface	22" Equivalent surface at 250 btu per sq ft	18" Actual Surface	18" Equivalent surface at 250 btu per sq. ft.
2	5	12	11.8	10	10.7	9	9.5	7½	8.2	6	6.7	4½	5.1
3	7½	18	16.1	15	13.9	13½	12.1	11¼	11.1	9	9.2	6¾	6.9
4	10	24	20.3	20	17.4	18	16.3	15	14.1	12	11.6	9	8.1
5	12½	30	24.6	25	21.1	22½	19.7	18¾	16.1	15	14.1	11¼	10.9
6	15	36	28.8	30	25.1	27	23.1	22½	20.0	18	16.5	13½	12.9
7	17½	42	33.2	35	28.7	31½	26.6	26¼	22.8	21	19.0	15¾	14.9
8	20	48	37.6	40	32.8	36	30.1	30	26.2	24	21.4	18	16.6
9	22½	54	42.3	45	36.4	40½	33.9	33¾	28.8	27	24.0	20¼	18.4
10	25	60	46.5	50	40.1	45	37.2	37½	32.0	30	26.4	22½	20.4
11	27½	66	50.5	55	44.1	49½	40.5	41¼	34.9	33	28.7	24¾	22.2
12	30	72	55.1	60	47.7	54	44.1	45	38.0	36	31.4	27	24.1
13	32½	78	59.7	65	51.4	58½	47.8	48¾	40.7	39	33.3	29¼	26.1
14	35	84	64.3	70	55.4	63	50.7	52½	43.1	42	36.2	31½	28.0
15	37½	90	68.1	75	58.7	67½	54.6	56¼	46.1	45	38.9	33¾	29.8
16	40	96	72.6	80	62.7	72	58.3	60	50.2	48	41.0	36	31.8
17	42½	102	77.2	85	66.7	76½	61.9	63¾	53.3	51	43.6	38¼	33.6
18	45	108	80.7	90	70.5	81	64.7	67½	55.9	54	46.1	40½	35.6
19	47½	114	85.3	95	73.5	85½	68.5	71¼	59.0	57	48.7	42¾	37.4
20	50	120	89.1	100	77.4	90	72.1	75	62.1	60	51.3	45	39.5
21	52½	126	94.2	105	81.3	94½	74.8	78¾	64.5	63	53.3	47¼	41.3
22	55	132	98.6	110	85.2	99	78.4	82½	67.6	66	56.2	49½	43.2
23	57½	138	103.2	115	89.1	103½	81.1	86¼	70.7	69	58.8	51¾	45.1
24	60	144	106.4	120	91.8	108	85.5	90	73.7	72	60.9	54	47.0
25	62½	150	110.8	125	95.7	112½	89.1	93¾	76.8	75	63.5	56¼	48.1
26	65	156	115.2	130	99.5	117	92.6	97½	79.4	78	65.9	58½	50.1
27	67½	162	119.6	135	103.3	121½	95.1	101¼	82.1	81	67.7	60¾	52.5
28	70	168	122.6	140	107.2	126	98.2	105	84.1	84	70.3	63	54.3
29	72½	174	126.9	145	110.1	130½	102.3	108¾	88.1	87	72.8	65¼	56.1
30	75	180	131.4	150	113.5	135	105.7	112½	91.0	90	75.2	67½	57.9
31	77½	186	134.8	155	117.2	139½	109.3	116¼	94.2	93	77.8	69¾	59.6
32	80	192	140.1	160	121.0	144	112.7	120	97.2	96	80.2	72	61.4
33	82½	198	144.4	165	124.8	148½	115.0	123¾	100.2	99	81.9	74¼	63.4
34	85	204	147.8	170	128.6	153	118.5	127½	103.2	102	84.5	76½	65.2
35	87½	210	151.4	175	130.8	157½	122.1	131¼	105.8	105	86.1	78¾	66.8
36	90	216	155.7	180	134.6	162	125.4	135	109.6	108	89.4	81	69.2
37	92½	222	159.0	185	138.3	166½	128.5	138¾	111.3	111	91.8	83¼	71.1
38	95	228	164.3	190	143.0	171	131.9	142½	113.9	114	94.2	85½	72.5
39	97½	234	168.7	195	145.8	175½	134.9	146¼	116.7	117	96.0	87¾	74.1
40	100	240	173.6	200	149.5	180	138.5	150	119.3	120	98.3	90	76.4

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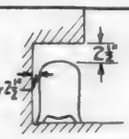
RADIATOR RATINGS—3-COL. STEAM, RECESSED | No. 14-N

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

Four-Column Steam, Recessed

4 COLUMN RADIATOR 

STEAM AT 215°F
RECESSED RATING

SECTIONS	LENGTH IN INCHES	45" Actual Surface	45" Equivalent surface at 250 b.t.u. per sq. ft.	38" Actual Surface	38" Equivalent surface at 250 b.t.u. per sq. ft.	32" Actual Surface	32" Equivalent surface at 250 b.t.u. per sq. ft.	26" Actual Surface	26" Equivalent surface at 250 b.t.u. per sq. ft.	22" Actual Surface	22" Equivalent surface at 250 b.t.u. per sq. ft.	18" Actual Surface	18" Equivalent surface at 250 b.t.u. per sq. ft.
2	6	20	18.7	16	15.3	13	12.9	10	10.1	8	8.5	6	6.5
3	9	30	25.5	24	20.7	19½	17.4	15	13.9	12	11.5	9	8.8
4	12	40	32.0	32	26.2	26	22.0	20	17.5	16	14.5	12	11.1
5	15	50	38.7	40	31.6	32½	26.6	25	21.2	20	17.5	15	13.4
6	18	60	45.6	48	37.6	39	31.3	30	25.0	24	20.6	18	15.8
7	21	70	52.6	56	42.1	45½	36.1	35	28.7	28	23.9	21	18.2
8	24	80	59.5	64	48.8	52	40.9	40	32.7	32	26.9	24	20.6
9	27	90	66.4	72	54.3	58½	45.7	45	36.3	36	29.1	27	23.1
10	30	100	72.1	80	59.9	65	50.1	50	39.9	40	32.9	30	25.5
11	33	110	80.0	88	65.7	71½	54.9	55	43.1	44	36.0	33	27.9
12	36	120	86.7	96	71.4	78	59.6	60	47.7	48	39.2	36	30.3
13	39	130	93.4	104	76.5	84½	64.3	65	51.3	52	42.3	39	32.7
14	42	140	100.7	112	82.4	91	69.4	70	55.2	56	45.4	42	35.2
15	45	150	107.2	120	87.8	97½	73.9	75	58.9	60	48.4	45	37.6
16	48	160	113.9	128	93.5	104	78.5	80	62.7	64	51.4	48	39.8
17	51	170	121.0	136	99.1	110½	83.4	85	66.5	68	54.6	51	42.4
18	54	180	127.4	144	104.6	117	85.1	90	70.3	72	57.7	54	44.9
19	57	190	134.0	152	109.7	123½	91.1	95	73.9	76	60.7	57	46.7
20	60	200	141.1	160	115.1	130	97.2	100	77.6	80	63.8	60	49.1
21	63	210	147.0	168	120.5	136½	101.7	105	80.1	84	66.9	63	51.6
22	66	220	154.3	176	126.5	143	106.6	110	84.7	88	70.0	66	54.0
23	69	230	160.2	184	132.3	149½	111.4	115	88.8	92	73.2	69	56.4
24	72	240	167.4	192	137.2	156	115.7	120	92.1	96	75.6	72	58.8
25	75	250	174.2	200	143.0	162½	120.3	125	95.8	100	78.9	75	61.3
26	78	260	180.7	208	148.9	169	125.5	130	98.7	104	82.1	78	63.6
27	81	270	187.3	216	153.4	175½	129.3	135	103.4	108	84.6	81	65.9
28	84	280	193.8	224	159.3	182	133.5	140	106.8	112	87.7	84	67.7
29	87	290	200.3	232	164.0	188½	137.8	145	110.5	116	90.8	87	70.2
30	90	300	206.3	240	169.1	195	142.3	150	113.9	120	93.7	90	72.3
31	93	310	212.1	248	175.1	201½	146.6	155	119.3	124	95.7	93	74.2
32	96	320	219.8	256	180.5	208	152.2	160	121.5	128	100.1	96	76.1
33	99	330	225.4	264	185.1	214½	156.2	165	124.6	132	102.4	99	79.2
34	102	340	231.4	272	190.9	221	160.2	170	128.2	136	105.6	102	81.6
35	105	350	237.6	280	195.4	227½	164.7	175	131.0	140	107.9	105	83.6
36	108	360	244.8	288	201.1	234	169.1	180	134.6	144	110.1	108	86.3
37	111	370	251.9	296	206.5	240½	174.0	185	138.8	148	113.5	111	84.4
38	114	380	257.2	304	210.9	247	177.1	190	141.7	152	116.3	114	89.1
39	117	390	263.4	312	216.1	253½	182.3	195	145.5	156	119.3	117	92.6
40	120	400	269.2	320	220.9	260	186.2	200	149.5	160	122.4	120	94.8

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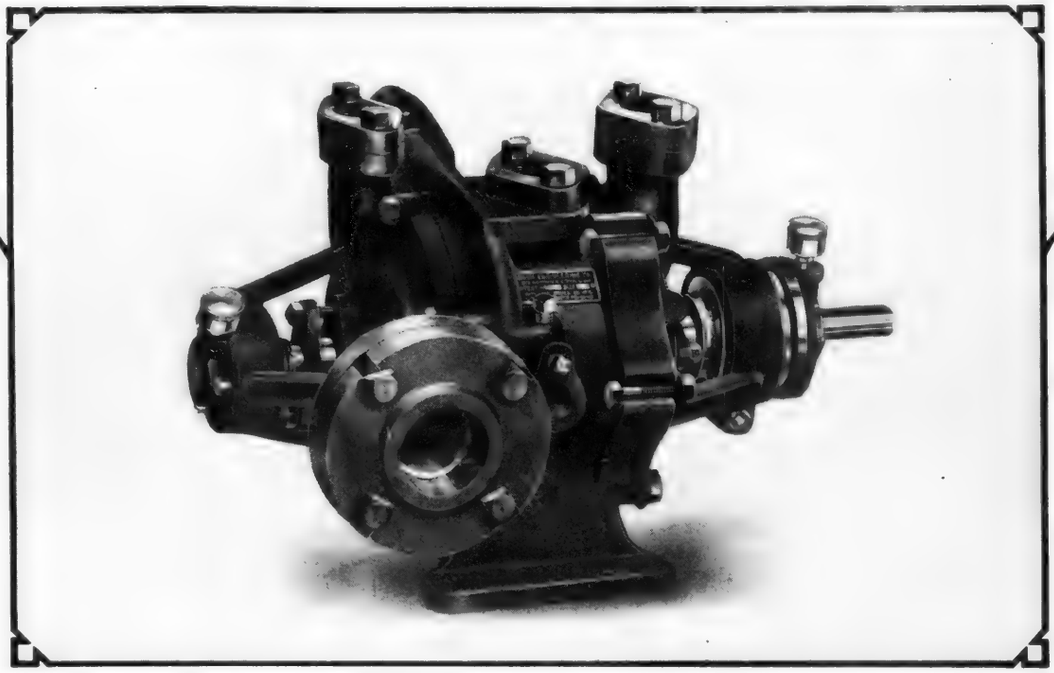
RADIATOR RATINGS—4-COL. STEAM, RECESSED | No. 14-O

Copies of this Data Sheet, printed separately, 5 cents each.



Jennings Hytor Vacuum Heating Pump, size C, suitable for 26,000 sq. ft. radiation. Only 2 H.P. motor, 1,800 R.P.M., is required when delivering from a vacuum of 10 in. mercury against 10 lbs. boiler working pressure.

Ample pump capacity guaranteed for the radiation specified

In any vacuum heating system, the overall efficiency secured depends in large measure upon the capacity of the vacuum heating pump installed. Unless this is properly determined, the results obtained will not be all that they should be.

Jennings Hytor Vacuum Heating Pumps are fully guaranteed to have ample capacity for the radiation specified. In recommending the correct size and type of pump, no item is overlooked that will help in meeting the given conditions most economically. Full consideration is given the equivalent radiation surface, degree of vacuum required at the pump, discharge head against which the condensation must be delivered, etc.

The importance fo correct recommendations cannot be estimated too highly. For the volume of condensation is likely to vary as much as 40%. Then too, the accompanying air, gases, vapors, etc., vary over a wide range,—depending on the initial and terminal pressures, the effectiveness of radiator traps, air inleakage, cooling effect in return lines, impurities in boiler feed, and other factors.

Nash Engineers are well qualified, both by experience and training, to cooperate with architects, engineers, contractors, and owners in selecting the proper heating pump for a given installation. They are at all times available to render whatever service they can in making heating systems as efficient as possible. Do not hesitate to get in touch with them.

Jennings Hytor

NASH ENGINEERING CO SOUTH NORWALK CONN

Trade and Miscellaneous Notes

Miscellaneous Notes

Building Operations showed a slight increase in August, according to the F. W. Dodge Corporation's statement for that month. Contracts awarded in the 36 eastern States (which include about seven-eighths of the total construction volume of the country) amounted to $354,442,700. The increase over July was practically 3% and over August last year, nearly 9%. Total construction started in the 36 eastern States during the first eight months of this year has amounted to $3,020,761,400, an increase of 11% over the corresponding period last year. In New York and northern New Jersey building contracts in August amounted to $86,817,500. This is a slight decrease from July, but an increase of 6% over August, 1923. The increase in total construction for the first eight months of this year in that section is 43% above the same period last year.

American Gas Association is holding its sixth annual convention in Atlantic City, October 13-17, 1924. A solution of the problem of how to meet the large scale demand for industrial and domestic gas heat is the keynote of the meeting. In addition to executives of the manufacturing gas industries, representatives of allied utilities are expected to participate in the discussion. A gas exhibit, in which 170 manufacturers are showing the most recent improvements in gas appliances, is a prominent feature of the convention. Of special interest to the heating industry are the addresses and papers on the application of manufactured gas to the problems of house heating. Among the papers on this subject are the following; "House Heating," by Charles Munroe, of St. Louis; "More Househeating Problems," by G. I. Vincent, of Syracuse, N. Y.; "Tank Heating," by Oscar Brown, of Chicago; "Heat Control," by W. M. Hepburn of New York; and an address on "What's Coming in the Heating Field," by Floyd Parsons, of New York. All of the papers mentioned are scheduled for presentation on October 15, while Mr. Parson's address will be the first item on the morning program of October 16.

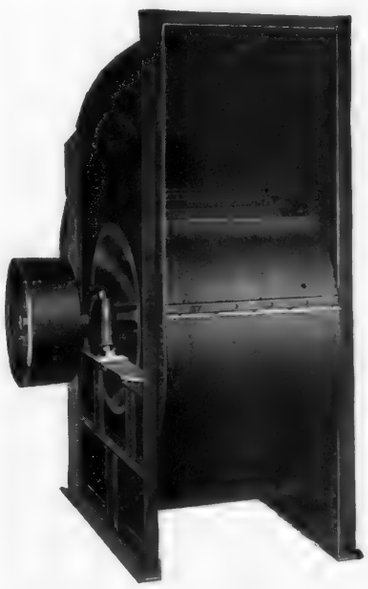
American Public Health Association will hold its fifty-third annual meeting in Detroit, October 20-24, 1924. Headquarters will be at the Hotel Statler.

Heating and Piping Contractors' National Association announces the appointment of Herbert A. Snow, of Boston, as chairman of its Membership Committee. The five zone chairmen are H. W. Lloyd, Springfield, Mass.; Harry G. Black, Philadelphia; E. D. Maurer, Cleveland, O.; E. J. Claffey, Chicago; and V. W. Guercie, Los Angeles, Cal.

American Construction Council held its annual meeting October 2-3, in New York. In addition to the regular business session, the meeting took up the subjects of better building, apprenticeship and the building congress movement. The serious situation which confronts the country because of inferior construction work and unsound financing was a vital subject at the convention.

Carnegie Institute of Technology, Pittsburgh, Pa., announces the renewal of its courses on heating and ventilation. Details are given in a recently-issued folder of the four-year course in heating and ventilating, including day and night classes. The four-year day course leads to the degree of bachelor of science in building construction. The folder also describes the one-year special course for men of advanced qualifications. Further details may be obtained by addressing the College of Industries, Carnegie Institute of Technology, Pittsburgh.

EFFICIENT VENTILATION DEMANDS UNIBLADE BLOWERS



The increasing favor accorded Uniblade Blowers clearly indicates the satisfactory work done by them on hundreds of installations in factories, industrial plants, theatres, schools and public buildings of every nature.

Quietly handling the required amount of air, it is no wonder they are daily specified on the particular jobs where dependable equipment is required.

On your next job be sure of results--specify Uniblade Blowers.

ACTIVE SALES OFFICES AND AGENCIES IN ALL PRINCIPAL CITIES

AUTOVENT FAN & BLOWER CO.
DEPT. "H"
730-738 W. MONROE ST. CHICAGO

Chicago, Ill.—The annual outing of the Chicago heating trades was held at Grass Lake, Ill., September 5-6. Over 100 were in attendance.

Manufacturers' Notes

Hart & Crouse Co., Utica, N. Y., announces the appointment of Warren S. Hillis as sales manager of the company. Mr. Hillis was formerly sales manager of the American District Steam Company, of North Tonawanda, N. Y.

C. A. Dunham Co., Chicago, which as announced last month, has acquired all of the capital stock of the Young Pump Company, of Michigan City, Ind., will not only continue the manufacture of the Young pumps but will incorporate into the Young pump development several independent patents pending, with basic ideas. In making the announcement of the transfer, Mr. Dunham states that "all Young patents, patent applications and contracts under which Young products are being manufactured have likewise been purchased and assigned in their entirety."

Mueller Co., Decatur, Ill., was host to 5,000 of its employees, firm members and families at the company's annual picnic in Fairview Park, Decatur, August 23. In the distribution of bonuses, 267 employees of the company were given $32,000 in bonus money for five, ten, fifteen and twenty years of service. During the day a bronze bust of Hieronymous Mueller was unveiled, the dedicating address being made by A. G. Weber, consulting attorney for the company, who paid a warm tribute to the memory of the founder of the Mueller Company, which he characterized as the greatest brass goods manufacturing plant in the world.

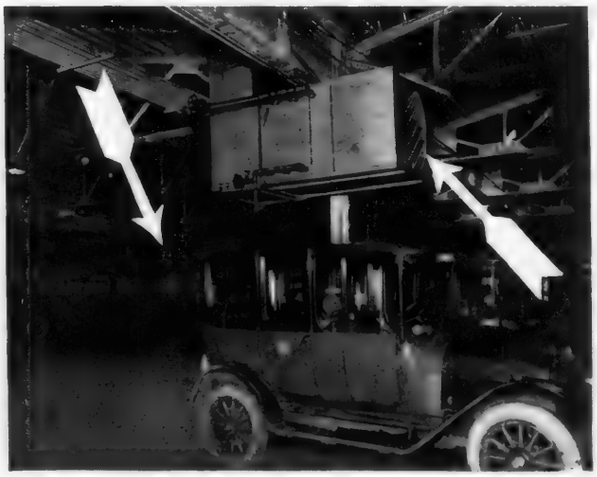
Hoffman Specialty Co., New York, has issued a new price list and discount sheet effective September 15, 1924.

Sanford Riley Stoker Co., Worcester, Mass., has recently taken over the entire business of the United Machine & Mfg. Co., of Canton, O., builders of the Harrington chain grate stoker. From now on the business of the latter company will be handled in the name of the Sanford Riley Stoker Company. The addition of the Harrington stoker increases the company's line to four types, the Riley, Jones, Murphy and Harrington stokers.

United States Radiator Corporation, Detroit, Mich., has removed its Phila-

The Garage Owner Is Interested in More Heat For Less Money

Built for placing on the floor or suspended from the ceiling. Furnished with Vento or Aerofin Heating Coils.



Ilgair Unit Heaters can be connected to the outside for introducing fresh warm air. Note by-pass connection in the picture.

No other active industry has as acute heating problems as confront the garage man. He is paying for heating two thirds of the space that is never used. He also needs fresh air to replace and force out automobile engine exhaust gases.

Ilgair Unit Heaters are scientifically adaptable for this purpose. Send for Circular.

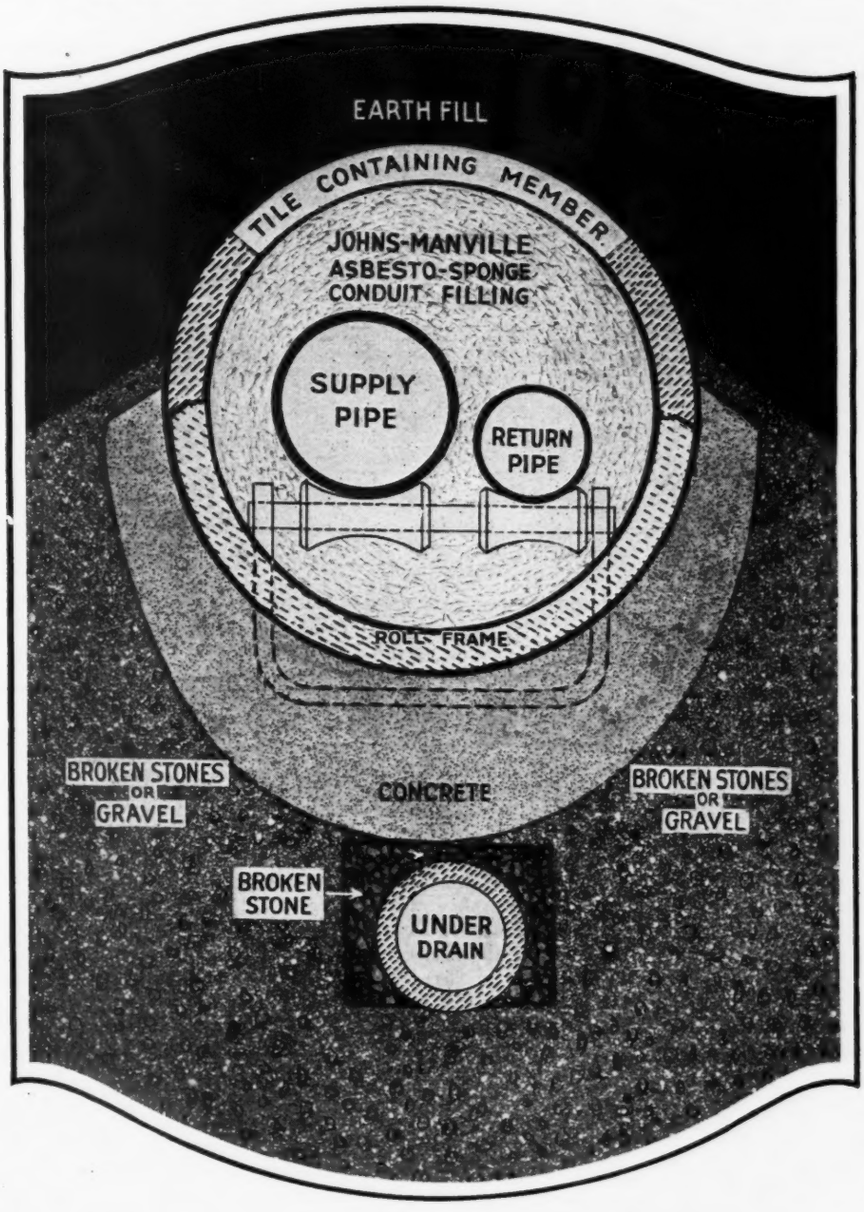
HIGH EFFICIENCY ILG VENTILATING MACHINERY

Ventilation

FOR OFFICES · STORES · FACTORIES · PUBLIC BUILDINGS · RESTAURANTS · THEATRES · HOUSES · ETC ·

ILG ELECTRIC VENTILATING CO. 2858 NORTH CRAWFORD AVE. CHICAGO

BRANCHES IN ALL PRINCIPAL CITIES



Efficiency—as specified

THE diagram shows a typical cross section of the Johns-Manville Underground System of Insulation for steam and hot water lines.

This system has a guaranteed efficiency of at least 90%—actually its efficiency is usually higher.

This high efficiency is the result of careful design and construction. Piping set on carefully placed, free-running rollers, with proper expansion joints, guard against failure of the pipe line itself. The Asbesto-Sponge Insulating Filler (an exclusive feature) has the highest insulating efficiency of any commercial material of its kind and maintains it in service.

Precautions against moisture keep this efficiency unimpaired. The two halves of the tile containing member have water shedding arc-bevel joints. Protection against flooding is provided by the broken stone or gravel bedding through which water quickly seeps to the open tile underdrain which promptly carries it away.

The entire system is built to give the highest efficiency and maintain it through years of service.

JOHNS-MANVILLE, Inc.
292 Madison Avenue at 41st Street, New York City
Branches in 62 Large Cities
For Canada: CANADIAN JOHNS-MANVILLE CO., Ltd., Toronto

Asbestos and its allied products
INSULATION
BRAKE LININGS
ROOFINGS
PACKINGS
CEMENTS
FIRE PREVENTION PRODUCTS

JOHNS-MANVILLE

Underground System of Insulation

delphia office from 34 South 16th Street to 220 South 16th Street, Philadelphia.

Thermal Appliance Co., New York, manufacturer of the Taco automatic water heaters, has appointed H. A. Hanson as a member of its sales force. Mr. Hanson's district includes New York City, Brooklyn, Connecticut and New York State up to Albany.

Langenberg Mfg. Co., St. Louis, Mo., is the new corporate name of the Haynes-Langenberg Mfg. Co., 4519 Euclid Ave., St. Louis, Mo. George F. Langenberg is president, Everett B. Langenberg, vice-president, John J. Walsh, secretary, and George L. Kleeber, treasurer.

New Incorporations

Economy Heating Co., Buffalo, N. Y., to conduct a contracting business in steam, hot water and warm air heating. The company has been organized by J. J. Landers, formerly research engineer of the American Radiator Company and has opened offices at 26 Triangle Street, Buffalo.

Socony Burner Corporation, New York, a subsidiary of the Standard Oil Company of New York, has been organized to manufacture and sell an oil burner for domestic heating boilers and furnaces. The headquarters of the company are at Second Avenue and 41st Street, New York. The new burner will be marketed under the name of the Socony Arrow oil burner. In order to be able to furnish service to its customers the company will confine its sales efforts at first to a limited area. For this reason the only direct sales and service branches so far established are at 345 North Avenue, New Rochelle, N. Y.; 116 Main St., Hempstead, L. I.; and 206 Wahlley Ave, New Haven, Conn. The president of the company is H. L. Pratt, who is also president of the Standard Oil Company of New York.

American Heating & Oil Burner Co., Spokane, Wash., capital $25,000. Incorporators: G. R. Clude, Ralph Lakin and Fred Pye.

Central Station Heating Notes

Bremerton, Wash.—An extension of the heating plant at the Navy Yard is to be made at an expense of $80,000.

Colorado Springs, Colo.—The formal agreement with the bondholders of the Colorado Springs Light, Heat & Power Company for the sale to the city of the heat distribution system for $600,000, is before the city council. The removal of the company's transmission line from the main part of the city has been asked by the city. Other demands of the city include payment by the company for the extension of the distribution system up to the time the property is turned over to the city, and payment of revenue derived from such extensions to the city.

Davenport, Ia.—The city steam heating rates for the coming winter have been lowered, according to an announcement of the People's Light Company, which furnishes steam heat to the large office buildings, apartment houses and store buildings of Davenport. This year the company is prepared to give service to over 150 customers, and blank contracts for this number have already been prepared.

Springfield, Ill.—Whether or not the furnishing of heat to a few residents living in the same block in which its plant stands makes the Central Public Service Company in Petersburg a public utility in that particular regard, especially since in furnishing this heat it uses no streets, is the question to be decided by Judge George W. Pillow, chief examiner of the Illinois Commerce Commission. Efforts are being made to have the commission force the company to resume the supply of heat which was stopped last spring. The company claims that when it purchased the property of the Abbott Light & Power Company, at Petersburg, the Abbott company was furnishing steam heat and hot water to the residents of the same block, which the purchasing company continued to do until this Spring, when it discontinued this service on the ground that it was operating at a loss.

Contracts Awarded

R. H. Jones & Co., Pittston, Pa., heating court house in Pittston for $17,700 (labor only). The Buffalo Forge Co., Buffalo, N. Y., will furnish the heating equipment at a cost of $24,000. The new plant replaces a furnace heating system installed 15 years ago.

Grand Island Plumbing Co., Grand Island, Neb., heating and ventilating new senior high school in Grand Island for $67,441.

New Firms

Martin T. Hooper, Los Angeles, Cal., has established an office at 634 I. W. Hellman Building, Los Angeles, as mechanical engineer, specializing on heating, ventilation and central heating plants.

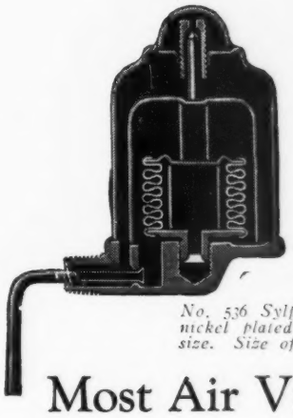
Business Changes

Samuel A. Esswein Heating and Plumbing Co., Columbus, O., has purchased the new White Motor Truck Building, at 548 West Broad Street, Columbus, which it will use as its headquarters. The company was formerly located at 96 West Broad Street, where it had been in business for 33 years.

The O. E. Frank Heating and Engineering Company Organized

The O. E. Frank Heating and Engineering Co., Buffalo, N. Y., has been organized by Mrs. Olive E. Frank, one of the two women members of the American Society of Heating and Ventilating Engineers, and for many years general sales manager of the Alberger Heater Co., of Buffalo. The new firm will be under Mrs. Frank's personal direction and offers a complete line of heaters, coolers, condensers and heat exchangers. Offices have been opened at 80 West Genesee Street, Buffalo.

SEE OUR DETAILED DATA IN A.S.H.&V.E. GUIDE
SEE OUR DETAILED DATA IN A.S.H.&V.E. GUIDE



No. 536 Sylphon Radiator Air Valve (cut open view). Made of brass, nickel plated all over and polished. Radiator connection ⅛" iron pipe size. Size of valve 1¾" in diameter by 3" high. Price $2.00.

Most Air Valves don't vent—*for long*

the float's too small and the diaphram's too weak

Goodness knows there's enough wrongful popular superstition and irritation about Plumbers without having so small an item as an air valve pile up more trouble.

Yet most radiator air valves do just that because they really haven't a chance to do an efficient job.

To do a real job, a Radiator air valve must have a large orifice, a man-sized float that will shut off against water, and a real powerful thermostat that will seal the valve tightly against steam.

Sylphon Air Valves positively and unfailingly vent for all time

The float in Sylphon Radiator Air Valve (No. 536) is a large, positive acting bell $1\frac{5}{16}$" in diameter. All Sylphon Air Valves (both radiator and quick vent) use the famous Sylphon bellows as their thermostatic element.

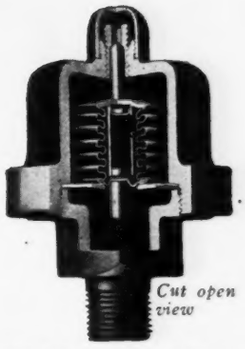
Drawn from a flat sheet of metal, without seams, the bellows is practically everlasting—and being of generous size ($1\frac{1}{8}$" diameter in No. 536), it develops great power and movement. This guarantees the valve to close tight against steam and be free from the constant danger of thermostatic breakdown.

To install Sylphon Radiator Valves is to secure both profit and lasting customer satisfaction. All jobbers carry stocks.

Send for Bulletin W. A. V.

Sylphon TRADE MARK

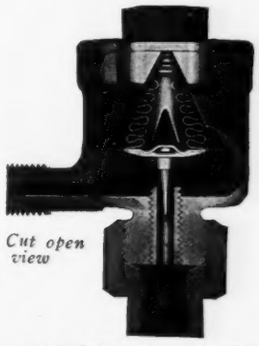
Radiator Air Valves & Quick Vent Valves Positively Vent all Air



Cut open view

No. 527 Sylphon Quick Vent Valve

Companion to No. 536. It needs no float because it is always installed above the water line at the ends of the mains and risers. Gives a one-pipe heating system flexibility and double satisfaction. Body of brass, plated all over. Size $2\frac{5}{16}$" diameter by $3\frac{5}{16}$" high. Price $3.00.



Cut open view

No. 410 Sylphon Air Line Valve

Vents air from radiators on air line systems. Sylphon bellows guarantees the closing of the outlet port, preventing escape of steam into the air line. Has ¼" male thread on inlet side and ¼" female thread on the outlet. Price $4.50.

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The Bayonne Housing Scheme

A unique housing scheme, designed particularly to meet the demand for homes for laboring people, is being carried out in Bayonne, N. J., by some of Bayonne's large employers, including the Bayonne Supply Company and the American Radiator Company. The plans call for the construction of model court apartment houses, five in number, to house 150 families. Hot water and heat will be included at a rental very much lower than the run of rents to-day. Particular care is being given to light and air in these apartments, as well as to playgrounds for the children on an inner court, also to comfort stations and rest rooms at the other end of the court, for grown-ups.

The history of the scheme, as well as details of its operation, are given us by Mr. Keenen, president of the Bayonne Supply Company and also president of the Bayonne Housing Corporation which is carrying out the project here described.

"About seven years ago," states Mr. Keenen, "DeWitt Van Buskirk, then president of the Chamber of Commerce, appointed a committee of three to study the housing conditions of the laboring people of Bayonne. This committee made a study and submitted a full report. The Chamber of Commerce then requested us to interest the industries of Bayonne in organizing a building company to build model homes for workmen."

The result was the organization of the Bayonne Housing Corporation of which Mr. Keenen is now president.

"Over a period of six years," continues Mr. Keenen, "we studied plans submitted to us for workingmen's homes and finally accepted those of Andrew J. Thomas, architect, of New York, who was the architect for the development work of the Metropolitan Life Insurance Company, on Long Island.

"The five buildings are now up to the second story and should be completed by the end of this year. They are to be operated by the housing corporation and are not for sale. The money for building them was subscribed by the industries of Bayonne and by several individuals. The rental of the apartments will be allotted to the various industries in proportion to the amount of their subscriptions, and we will not rent to outsiders unless the industries fail to keep them occupied.

"The apartments are five and six-room suites, all six-room apartments having two baths."

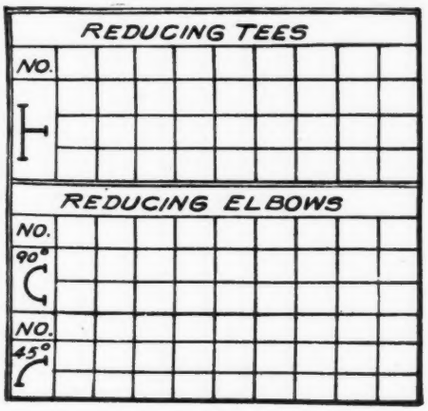
The full list of subscribers to this project are: International Nickel Co., Tide Water Oil Co., Pacific Coast Borax Co., Standard Oil Company of New Jersey, Vacuum Oil Co., American Radiator Co., Babcock & Wilcox Co., Estate of J. H. Mahnken, Bayonne Supply Co., John D. Rockefeller, John D. Rockefeller, Jr., and the Harkness Estate.

A Kink for Checking Materials

By W. F. Schaphorst, M. E.

Here is an ingenious and simple method for keeping a record of pipe fittings.

For example, where reducing tees have three different sizes of openings, as often happens, the problem of recording those openings in an orderly manner has heretofore always been a stickler. The accompanying reproduction of a blank used by a large eastern engineering concern shows how easily it can be done.



Form for Keeping a Record of Pipe Fittings

Similarly, reducing elbows and return bends can be checked or recorded on the same blank. The blank therefore tells the whole story without the necessity of vexing explanatory remarks such as are to be found attached to the usual variety of records pertaining to fittings of this character.

WANTED

Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisement contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

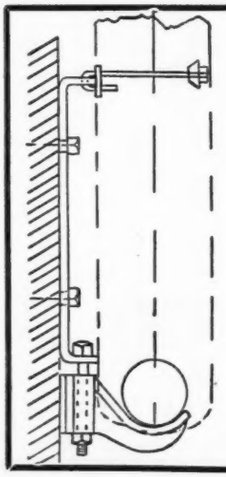
SALESMEN WANTED — Salesman wanted to call on heating and ventilating engineers, superintendents and engineers of buildings, and ventilating contractors, to handle instrument as side line. Substantial commission. Address Box 100, care of Heating and Ventilating Magazine.

SALES ENGINEER WANTED— Sales engineer wanted to establish eastern branch for handling New England territory for western domestic oil burner manufacturer. State qualifications. Address Box 101, care of Heating and Ventilating Magazine.

SHEET-METAL LAYOUT MAN WANTED—Wanted, in California, experienced ventilating sheet-metal layout man. Good opportunity for permanent responsible position. Give experience and reference. Address Box 102, care of Heating and Ventilating Magazine.

POSITION WANTED — Heating and ventilating engineer, technical graduate, 18 years broad training and responsible experience in both engineering and contracting fields, designing, superintending, estimating and installing, available for position of responsibility requiring energy, tact and stability. Address Box 103, care of Heating and Ventilating Magazine.

ENGINEER WANTED—Heating and ventilating engineer wanted for large corporation. Must have experience and ability to specify and design factory heating and ventilating equipment. In reply state experience in detail, references and salary required. Address Box 104, care of Heating and Ventilating Magazine.



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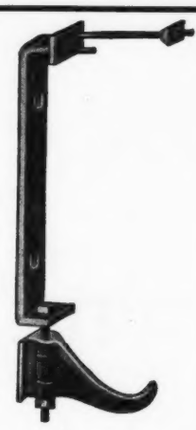

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